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Home Computing with OS/2

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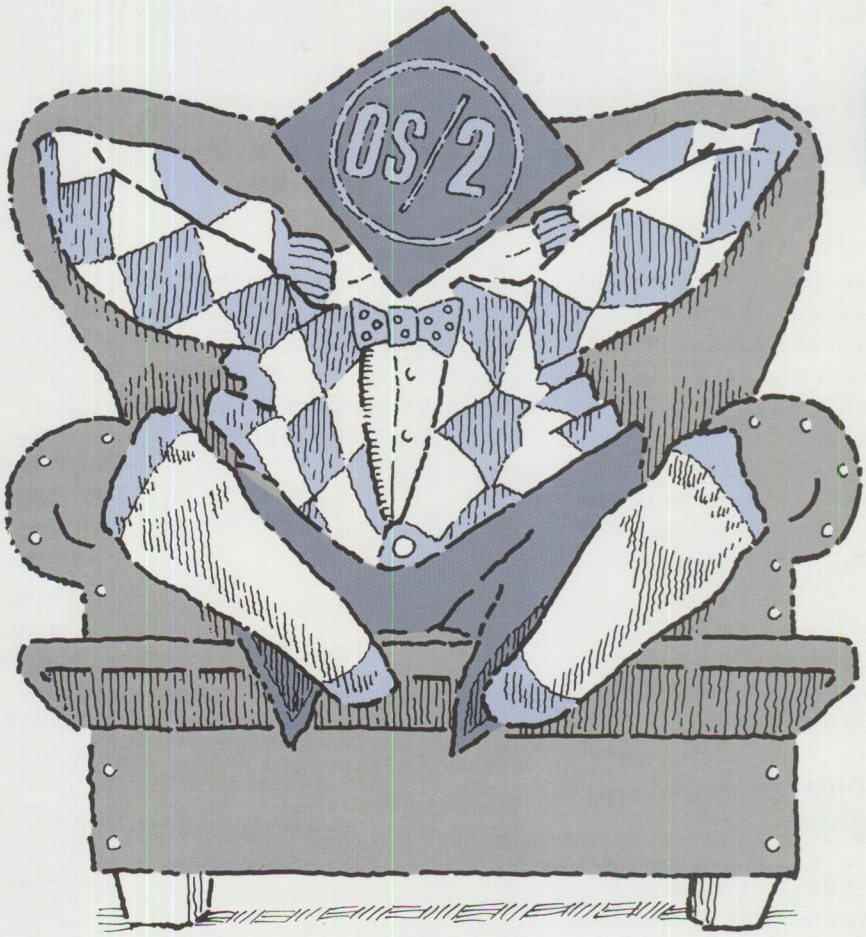
This article presents visions of home computing today and tomorrow using OS/2. The article covers a myriad of ways to use computers at home, and shows how OS/2 makes it easier to perform those tasks. In this article are discussions of home-computing requirements, as well as lots of practical tips for using OS/2 at home.*



What is the future of computing? Try 2.5 PCs in every home by the end of the 1990s. That's the view of Channel Marketing Corporation, the Dallas market research and consulting firm, which projects that more than 100 million computers will be sold in 1999 (not *by* 1999).

What are the market drivers? Parents working more at home. Kids' education. Hand-held and notebook PCs. And interactive TV.[1]

IBM is in a unique position to take the lead in computer growth for the home, because of its collection of enabling technologies, skills, and alliances. IBM technologies will make personal computers more portable, more powerful, and much easier to use, expanding their role and improving their benefit. As collaborative business systems, they'll help you stay in touch with people and information, any time and anywhere you happen to be. And as personal agents, they'll act as your partner and advisor letting you spend more time with family while improving business effectiveness. You'll have more freedom over where and when you work and live.

OS/2 at Home

This article is intended to show existing PC users how IBM technologies can be applied to home computing applications, and how OS/2 provides unique benefits as a PC operating system for the home. There is still much work to be done to make OS/2 (and personal computers in general) more of a consumer product like the telephone, TV, or VCR. Almost every household in America has a phone and TV; many have several. Computer technology, however, is still too new, lacks compelling applications, and is too difficult to use for many consumers to be interested. That's the current view, but OS/2 is helping to change that view.

[1] Tom Steinert-Threlkeld, *The Dallas Morning News*, July 3, 1993, page F1.

OS/2 has the potential to change the way you use your computer, elevating it from hobby status to home appliance and tool, and increasing its value to you and your entire family. This guide includes a vision of home computing that happens when you leave your computer powered on and run a multitasking system like OS/2. It then describes how to happily apply OS/2 technology today. Although OS/2 is known as the world's leading system for enterprise computing, you'll soon discover its potential in the home.

Operating System/2 Highlights

OS/2 2.1 is the latest release of IBM's award-winning PC operating system. OS/2 Version 2 was more than a new version — it was a new vision and a breakthrough operating system that exploits the power of today's 32-bit, Intel**-based processors (386, 486**, etc.). It takes your PC applications beyond the limitations of the past, and lets you do more with them than you ever could with DOS or with DOS plus Windows. It also lets you run tens of thousands of DOS, Windows, and OS/2 applications, and run them concurrently — an important capability for the work-at-home household. In other words, OS/2 offers true multitasking.

"But wait a minute. Why should I care about multitasking?" you may ask. "I do only one thing at a time." That's because your PC operating system lets you *do* only one thing at a time. Is your dinner prepared this way?:

1. Pour a drink.
2. Drink it all.
3. Prepare a salad.
4. Eat the whole salad.
5. Prepare a potato.
6. Eat the whole potato.
7. Prepare the meat.
8. Eat all the meat.
9. Prepare dessert.
10. . . .

No! As ridiculous as this scenario is, it makes you wonder why anything would work that way. A cook sets up each item, cooking and switching between tasks as he or she feels necessary. A cook handles interruptions, such as a pot boiling over, and switches attention as needed. The potato and steak continue cooking (in the background) while the cook takes the pot off of the burner or prepares the dessert.

A computer should do the same, and it can with OS/2. And with OS/2 Crash Protection, each running application is protected from the next, so if one fails, it won't affect the others.

About the only thing better than how much OS/2 can do is how easily it does it all. There's a graphical interface — the Workplace Shell* — that makes OS/2 easy to install, learn, and use. And OS/2 comes with a collection of support services, including a toll-free number.

Maybe the best part is that instead of buying DOS, Windows, and other software to get more out of your computer, you get them all with OS/2. So for a whole lot less, OS/2 gives you a whole lot more.

That's why over two million copies of OS/2 were sold during its first nine months, and why hundreds of hardware vendors and thousands of software developers are supporting it. Now, version 2.1 is available, with even more features and even better performance.

OS/2 Is Versatile: It runs virtually all DOS, Windows and OS/2 applications from a single system. OS/2 2.1 adds support for Windows 3.1 and Windows Enhanced Mode applications. You can even run Standard Mode and Enhanced Mode applications at the same time.

OS/2 Is Fast: It makes the most of your 32-bit hardware (Intel 386 SX and above). OS/2 removes the memory limitations of DOS, and gives your programs more space to grow. By using your disk drive and virtual storage technology, OS/2 lets your application programs think they each have up to 512 million bytes of memory. OS/2 runs the fastest 32-bit applications and the older 16-bit DOS and Windows applications. In general, it runs them as fast or faster than under native DOS or Windows.

OS/2 Is Simple: OS/2 includes the Workplace Shell, a state-of-the-art graphical interface that is easier to learn and use than other graphical windowing systems. If you are already a Windows user and don't want to take time learning a new interface, you can start any of your DOS, Windows, or OS/2 programs from a familiar Windows interface. As you learn more about the Workplace Shell, however, you'll likely make the switch to improved productivity.

OS/2 Is Technically Superior: OS/2 has been praised for its pre-emptive multitasking, overlapped I/O, High-Performance File System (HPFS), and Crash Protection*. Although most of the application examples used in this paper can be done today on DOS and Windows, this paper shows why OS/2 is a superior environment for running those applications.

OS/2 2.1 Includes Built-in Multimedia Support: It accommodates popular sound cards and CD-ROM drives, and includes software to support audio (record and play), and software motion video (play).

If your computer has a 386 SX or better, you should consider OS/2 2.1, so you can exploit the 32-bit power you paid for. With OS/2, you can finally do the only thing you haven't been able to do with your computer — make the most of it.

OS/2's reliable multitasking lets you leave your system powered on with your favorite applications just an icon away, while service applications (such as fax and phone mail, and energy and security management) run in the background. OS/2 runs well on most of the current systems being sold, since they are typically 386- or 486-based.

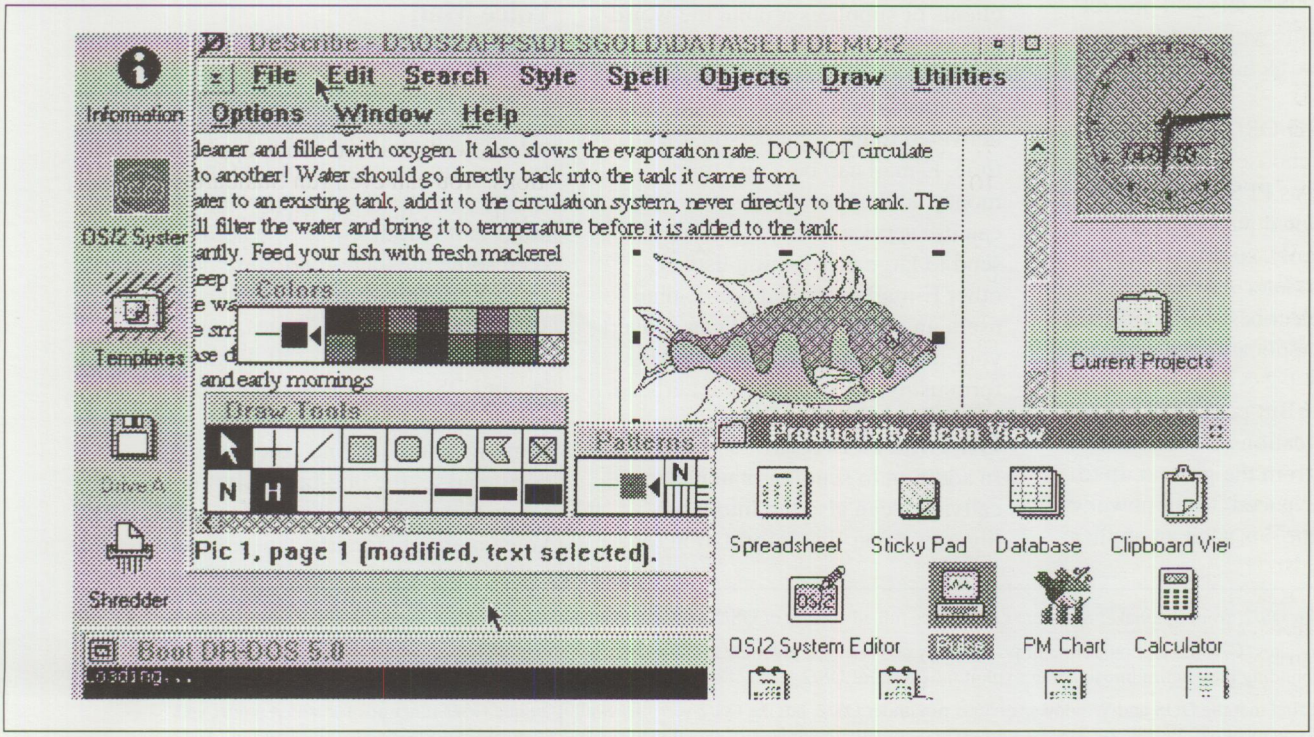
A Vision of Home Computing Today

Today's Advantages for the Work-at-Home Office

For the many people who work out of their homes, OS/2 provides an ideal operating environment for productive multitasking. For others, who buy home computers so they can bring office work home and spend more time with their families, OS/2 offers the freedom to run the DOS or Windows applications that you might already have at home, as well as the OS/2 applications that you run at the office — and it offers the power to try new OS/2 applications at home while your office mates still trudge along with DOS or Windows.

Choosing Application Software

OS/2 comes with a collection of applications and games that provide instant productivity. They include a



DOS Support Is Included, but You Can Still Boot Your Old Copy of DR DOS — While Running New 32-bit Applications

basic spreadsheet, database, graphics editor, calculator, calendar, daily planner, communications program, and more. You can also choose from the vast selection of supported software:

- 30,000+ DOS applications
- 7,000+ Windows applications
- 2,500+ 16-bit OS/2 applications
- 1,300+ 32-bit OS/2 applications

The leading categories of application software haven't changed in years. The top five (in order of popularity) still include word processing, database management, presentation graphics, spreadsheet, and accounting/budgeting. Application software can be found today for everything from writing a business plan to managing sales, advertising, and personnel. Although new 32-bit applications are available in all major categories, you may have existing preferences or a need to run older 16-bit applications. OS/2 lets you protect past investments while moving forward with new technologies.

When selecting OS/2 applications, some people choose an integrated package such as PFS:Works.[2] Others choose individual packages from a consistent family, such as that provided by Computer Associates.[3] Still others will select best-of-breed packages in each application category, such as Lotus 1-2-3 and WordPerfect.[4] But perhaps the most exciting applications are the new ones written from the ground up to exploit the advanced 32-bit power of OS/2. DeScribe** is such an application. If you desire an OS/2 application that combines advanced word processing functions with powerful desktop publishing features and extensive drawing capabilities, there's really just one word to know — DeScribe.

Telecommunications

Whether it is facsimile or data, communications is one of the most compelling reasons for OS/2's multitasking features. OS/2 lets you send or receive a fax, download mail or programs from a BBS, and even run your own BBS in the background — all while doing other PC tasks, such as writing a letter or printing in the foreground.

Electronic Mail

Forget printing, stuffing envelopes, licking stamps, frantically running to the post office, and paying for overnight services to meet a deadline. With a modem and E-mail (as with fax), you can send memos, letters, and other information to your clients or suppliers around the world and around the clock — at 3:00 a.m. if you like. With a press of a key, your message is signed, sealed and delivered to the right person, on time. E-mail can be a real time, money, and aggravation saver. You can use services like MCI Mail to send to large distribution lists of other E-mail users and non-E-mail users, in which case MCI can convert your documents to fax or printed form using your company letterhead.

On-Line Services

In addition to sending mail electronically, you can also tap into large libraries of on-line information to read the day's news, see the latest stock quotes, reserve an airline ticket, do your banking, and order anything from office supplies to a new wardrobe. You can even turn your own PC into an on-line service or bulletin board system (BBS), letting other PC users access your inventory, products or information, and place orders. When selecting a modem to connect to an on-line service like CompuServe**, PRODIGY**, or America Online**, modem speed and data compression are primary factors.

Advanced Telephone Features

You can use your PC and modem to add convenience features to your telephone. These include auto-dialing, automatic callback of busy numbers, activity reporting (especially useful if billing for your time), and caller identification (requires a phone line feature) to display the database record of the person who is calling, or to screen out unwanted calls.

Voice Mail

More of today's work-at-home offices have telephone answering machines (66%) than have PCs (51.3%).[5] For business use, the inexpensive models that record on magnetic tape suffer from a lack of important features (e.g., the ability to keep some messages and erase others). Digital answering machines address some of these issues, but are costly — as much as $200. With a PC and OS/2, there is another alternative. Some of today's modems combine data, fax, and voice functions, and let the one-person home office compete with the big guys. Voice mail replaces the tape answer-

[2] PFS:Works** for OS/2, from Spinnaker Software Corp, takes full advantage of OS/2's power and function and retails for just $149.

[3] Computer Associates (CA) has a popular line of productivity and business software for Windows. Although these packages can already run under OS/2, CA is rebuilding their entire line to better exploit the power of OS/2.

[4] Again you will find that the DOS and Windows versions run under OS/2, but the OS/2 versions exploit unique OS/2 functions for added power and convenience. As an example, WordPerfect** 5.2 for OS/2 comes filled with best-of-breed features and advanced Workplace Shell integration. And with OS/2, you can exchange information between applications that never knew they would be working together, so the new ones you buy will work with the old ones you already have.

[5] Source: Link Resources.

ing machine that is insufficient for business use. With it, you can offer lots of choices ("press 1 for customer service; 2 for sales; 9 for world peace"); you can select which messages to listen to; and you can delete some messages while you keep or forward others. Data/fax/voice modems are available from vendors such as AT&T, Micronix, and IBM[6] (see below), and cost as little as $399 including software.

Facsimile

Stand-alone fax machines are another popular investment for the home office, but rather than rush out and spend $400 for a low-cost fax machine (or up to $3000 for one with rich features), consider a fax modem instead. A fax modem does everything that regular modems do, like connecting you to services such as PRODIGY, CompuServe, and bulletin boards, but it also sends and receives faxes. When sending a fax straight from your PC application, however, the quality is much better than sending from a fax machine. It's almost as good as a laser printer. So now your PC can serve as a top-of-the-line, plain-paper fax machine, capable of sending dozens of faxes with the push of a button. Best of all, it costs less than a traditional fax machine — under $150 for the software, or $300 for adapter card and software.

Some sample fax software products include:

- BitFax** for OS/2, $99, Bit Software, Inc., 1-408-263-2197
- FaxWorks for OS/2, $149, SofNet, 1-800-432-9967
- Fax/PM**, (price varies with configuration), Microformatic USA, 1-203-644-1708
- Home Office**, $299, Prometheus Products, 1-800-477-3473 (modem and software)

These products offer a variety of rich features, including sending faxes with your letterhead and signatures. Getting them into your system the first time is easy. Just use a fax machine to send your stationery to yourself. When broadcasting group faxes, each fax could have a different message on the cover sheet, and the entire job can be scheduled for midnight, when long-distance rates are lower. Incoming faxes can be forwarded to another machine when you are not there to receive them. And OCR (optical character recognition) software can convert fax images into editable text that takes less hard disk space to store and 50% less time to print.

There are some (usually minor) drawbacks to faxing via modem. You won't be able to send original paper documents without also buying a scanner and going through the extra step of scanning the document into the PC. Faxes, especially those with lots of graphics, take up lots of disk space. You'll likely want to delete fax images once they are printed. In general, though, you'll get more fax features with a PC than with a stand-alone unit, and you'll be able to do some neat tricks that just aren't possible otherwise.

Fax-on-Demand

This technology is a merger of telephony, fax, and database applications, and was once affordable only by large companies. Your customers can now dial into your PC to "request" specific fax documents. Recorded telephone messages prompt the user to select document numbers through the telephone keypad, then ask for the phone number of their fax machine. Finally, the documents are faxed automatically. Two examples of software to create fax-on-demand systems include:

- FaxForward**, $1,495-2,495, Computer Systems Integration, Inc., 1-401-331-1117
- Open+Fax**, $1,795, Open+Voice, Inc. 1-214-497-9022

Family Advisor

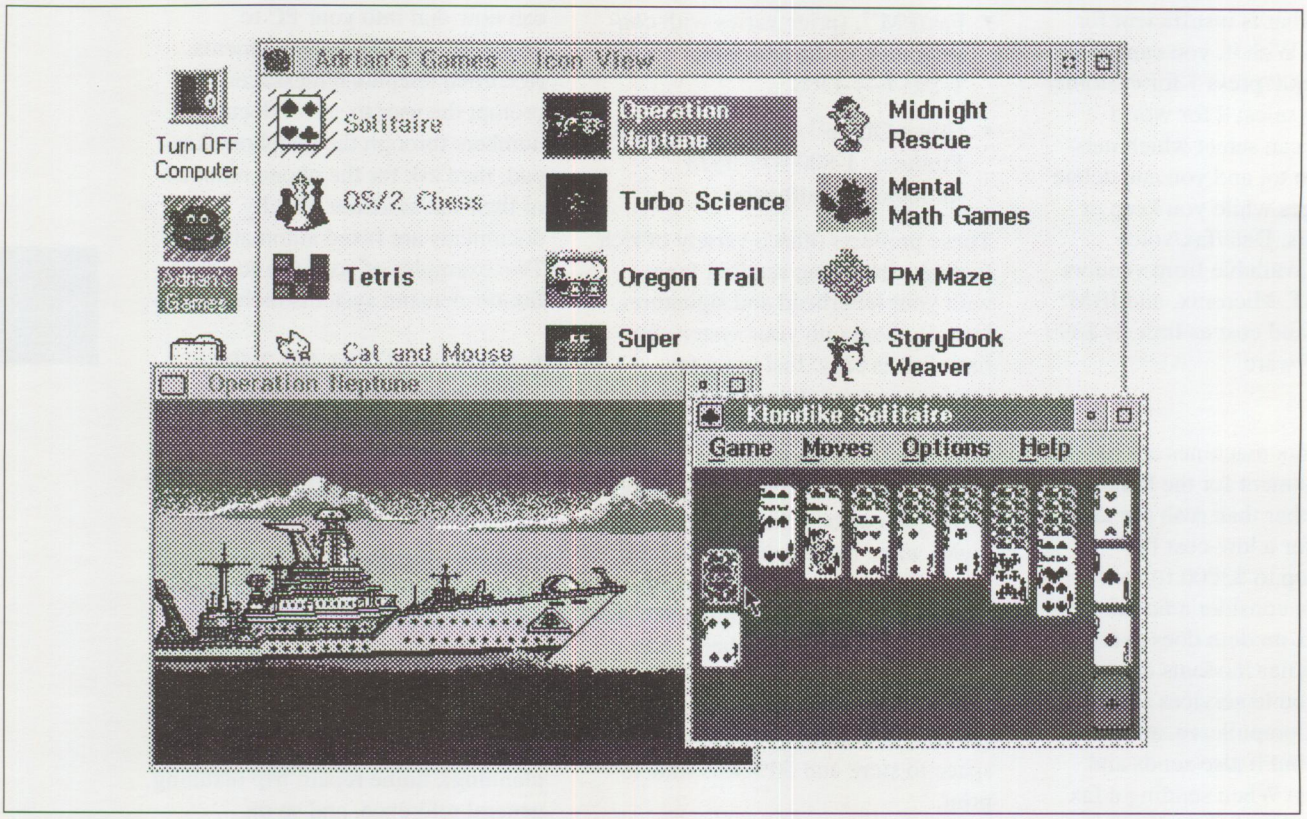
Many available PC programs play an advisory role. They cover financial issues (budgets, taxes, estate planning, net worth), legal issues (writing wills, lease contracts), medical issues (first aid, diet planning, exercise planning), home repair, trip planning, general reference, and so on.

Again, most of these programs can run under DOS or Windows, but OS/2's multitasking can make using them more convenient. OS/2 can also make it easier to exchange information between programs, using techniques such as cut-and-paste, dynamic data exchange (DDE), object linking and embedding (OLE**), and more. This is one reason IBM calls OS/2 "The Integrating Platform."

Financial Management Software

This is a class of home applications that are used to write checks, manage budgets, and gather data for taxes. Examples include Managing Your Money, Microsoft Money**, and Quicken**. Information is entered only once, instead of being written

[6] For just $399, the IBM Mwave* WindSurfer* Communications Adapter utilizes Mwave technology to consolidate the separate data/fax modem and voice messaging, and telephone answering functions, into a single add-in card with supporting software for the DOS/Windows environment. Even greater benefits for the home office, however, will come with planned OS/2 support and the programmability of the Mwave Digital Signal Processor (DSP) developed by IBM, Texas Instruments, and Intermetrics. Because the DSP is programmable, the WindSurfer can acquire new functions through software upgrades. Functions such as higher-speed modems, stereo sound, MIDI, speech recognition, text-to-speech, image compression/decompression, and even motion video acceleration are possible without changing the hardware.



Play Our Games or Yours

first on the check and then into the check register. The system makes even that one entry easier by keeping track of repetitive payments.

Newer printers allow you to insert single checks from your checkbook, so you don't even need special forms if you want the computer to print your checks for you. With the right printer, you won't have to change printer paper.

Although this kind of application can run under DOS or Windows and use any printer, you'll find that it becomes easier to justify (and a joy to use) if you choose the right printer and leave the system powered on with OS/2 and the application started and waiting in the background — waiting to write your next check.

On-Screen Reminder System

One of the most important things needed for the productive home office is self-discipline. OS/2 can't substitute for this personal trait, but it can help. It comes packaged with alarms, a calendar, a daily planner, and an electronic sticky pad. If you are already used to using the basic calendar that comes with Windows, you'll find it included with OS/2 too. These simple tools can prove useful to an individual who has his or her office at home, or a family that needs to post messages and reminders to each other. You may never miss another birthday or anniversary!

Education and Games

Freedom of choice is an advantage when selecting business software and for educational software and games too. While you use the PC for business, your children can use it to create their own music videos, take imaginary trips down the Amazon, or practice economic skills by running a dinosaur theme park. All this in the name of education.

Textbook publishers are starting to produce software alternatives, now that big states like California and Texas are beginning to allow textbook budgets to be spent on software. Optical Data's "Windows on Science," a videodisc-based science program, was adopted by the state of Texas in 1990 as a textbook alternative. California has put out a framework for education that requires technology to be integrated with any printed material, especially in math, by 1995.

Unlike school software, however, home education products must compete with all other things a kid could be doing — like watching TV, playing video games, even reading a book. Home software must be fun, or it will become shelfware. By exploiting today's computer hardware, advanced graphics, and sound, new programs (like Davidson's "Math Blaster," which lets kids solve math problems by blasting numbers out of the sky) have given birth to the new term "edutainment" to describe software that both teaches and entertains.[7]

Multimedia

Two of the most exciting technologies to affect education are multimedia and the optical compact disk (CD-ROM). The CD-ROM drive can play music from audio CDs, and can also access up to 600 MB of data on computer CDs. With access to so much storage, the games and educational software delivered on CD are rich in exciting images, digitized voice and music, animated graphics, and even TV-like video. Because entire multimedia encyclopedias can now fit on a single compact disk, more electronic encyclopedias are sold today than printed ones.

OS/2 is an ideal environment for running your DOS games and multimedia applications, especially if something else needs to run as well (like fax or voice mail). It effectively supports the heavy demands of sound, image, animation, and video that weren't even considered when DOS was written. Unlike word processors and other business software that gracefully wait until their turn to use the central processor, multimedia applications can't tolerate delays without a loss in presentation quality. Video must be delivered fast enough so as not to appear jerky, and sound must be synchronized with the action. OS/2 supports preemptive multitasking that can guarantee responsiveness to your multimedia applications, so you don't have to dedicate your computer to running a single program.

With the release of OS/2 2.1, Multimedia Presentation Manager/2* (MMPM/2*) is packaged with OS/2. It supports a wide variety of CD-ROM drives and sound cards, and can even handle concurrent use of the sound card by game and music software, so you can listen to Mozart and the sound effects of your action game at the same time. And it comes with a collection of sounds that are associated with system events, such as opening or closing a window, picking up or dropping an object, and information or warning messages, thus transforming the OS/2 desktop into a multimedia-enabled workplace.

Music Education

You would like Johnny to learn to play the piano, so you buy an electronic piano keyboard, and with it you get a software package that teaches music theory and composition, stores songs, prints sheet music from the score, and electronically scans in sheet music, converting it to MIDI formats for editing and playback in CD quality.[8]

Graphics and Photographs

OS/2 can help when working with computer graphics. Graphic files with high resolution and lots of colors can be quite large. Editing them can require lots of storage, often more than DOS allows, especially if you have any special device drivers. OS/2 gives your DOS applications access to more storage, making new functions possible and improving the performance of existing functions. OS/2-specific applications have access to even more memory, and can benefit from 32-bit performance and virtual storage.

The Kodak Photo-CD** lets you take your 35mm film to be processed and get back the prints and an optical disk with digitized images. The images can be read from a CD-ROM XA drive, and displayed on your computer. You can even edit copies of the pictures, and print them or include them in documents. With Kodak's exciting new technology and a CD-ROM XA drive, the power of multimedia is available to anyone with a camera.

Video and TV

Add-on products like IBM's PS/2 TV* let you view TV broadcasts in a window or full screen on your computer monitor. You can simultaneously connect to your telephone and TV cable to check the morning news and weather on PRODIGY while watching "The Today Show" in a TV window.

OS/2 2.1 includes built-in support of a new type of video, called digital video, with no need for additional hardware. In contrast to analog video (for example, TV broadcasts), digital video lets you electronically retrieve and play video clips from your hard disk or CD, access digital interactive TV for education and games, or participate in a video conference with someone anywhere in the world. Advances in communication speeds promise to make video conferencing a mainstream application, letting you spend more time with your family, or

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[7] *Computer Letter*, May 24, 1993, Volume 9, Number 17, pages 1-7.

[8] The IBM WindSurfer provides CD-quality stereo sound with sample rates up to 44.1 kHz. Its state-of-the-art Musical Instrument Digital Interface (MIDI) sound comes from digital samples of actual instruments instead of from a combination of noises that make music, a common technique used in today's sound boards.

giving you more choice over where you live.

Special Needs

For most people, technology makes things easier. For the disabled, technology makes things possible. The PC can be the window to much of the world for the blind and others with vision problems, and it offers new hope to the deaf, the voiceless, slow learners, the mentally retarded, people with brain injuries, and — most dramatically — to those contending with severe mobility problems.[9] When the appropriate equipment is attached to a PC, these people can control their environments, and communicate with virtually anyone with little or no assistance.

A wide array of products already exist to aid the disabled, including systems that talk, listen, teach, communicate, and translate for the user. Although most of these products are designed for DOS, OS/2 lets them work together with other applications. Suppose that Grandfather, for example, has difficulty reading a newspaper because of failing eyesight. With OS/2 and PRODIGY, he can download and read his personalized "electronic" newspaper, specially enlarged and displayed on a big screen that has been customized with his favorite colors and large fonts.

Combined with voice recognition and home automation (see Home Network and Automation), the PC also recognizes Grandfather's spoken commands, so he doesn't have to get up to turn on the lights or make a phone call.

Voice Recognition

IBM's desktop dictation technology provides the most accurate, sophisticated speech recognition capabilities available today. Featuring a 20,000-word vocabulary, it takes dictation at a throughput rate of more than 70 words per minute. What makes it unique is its use of advanced algorithms, developed by IBM Research, to analyze acoustical data and word sequences to correctly choose between like-sounding words, — "to," "two," "too," or "our" and "hour" — and to recognize the start of a sentence and provide capitalization. In addition, IBM's desktop dictation technology has navigation capabilities that let users give voice commands to move around within their document or within the system while dictating. You can control the operation of your PC using voice commands and a microphone today. Tomorrow you'll also be able to use a telephone and intercom (always listening) for input.

Your home network can connect more than just personal computers. It can also include an array of intelligent devices for complete home automation.

With voice recognition, you can dictate your letters (or even a book) instead of typing them. When combined with voice synthesis software, you can call your computer to request that your electronic mail or faxes be read to you over the phone, and then dictate your response, which is sent as though you had typed it.

Language Translation

Within five years, we'll also start to see the impact of real-time language translation. This future technology will let you talk to someone in Mexico who does not speak or understand English. The computer will be your translator. But this is in the future, and belongs in the next section. OS/2 is here *today*.

A Vision of Home Computing Tomorrow

Tomorrow's Promise for the "Electronic Home"

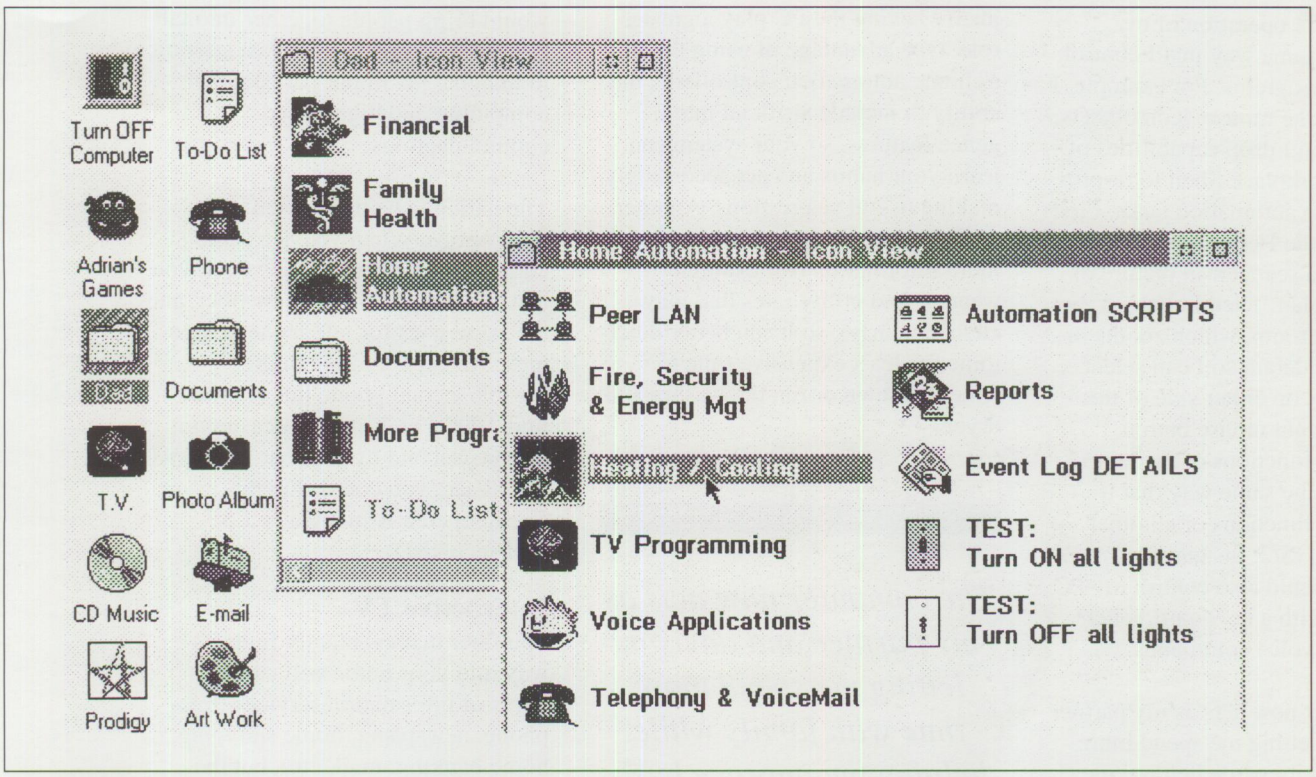
Up to this point, we've covered what can easily be done today. Now, we'll look at the future of home computing, knowing that some of the applications are already in use by early adopters today, and that others are still in development.

Home Network and Automation

Children studying for school on the PCs in their room share information with the master PC in the den. From their PC, they can print on the downstairs printer, use its modem to access PRODIGY and dial into vast libraries, or access its CD-ROM drive and multimedia encyclopedia. Today, they may use DOS or Windows on desktop PCs, and connect via an unused phone line, but soon they'll use sub-notebook systems and wireless networks. You too will use sub-notebook or hand-held computers, and wirelessly connect to mail services or your home computer, keeping in touch any time and anywhere you happen to be.

But your home network can connect more than just personal computers. It can also include an array of intelligent devices for complete home automation. As appliances gain computer intelligence, the differences between PCs and intelligent devices will blur. You'll likely see PC technology in televisions, and could even see it built into the refrigerator door.

[9] IBM's National Support Center for Persons with Disabilities was created to help professionals and others learn how computers can enhance the work and life styles of people with disabilities. To visit the Center, or for more information, call 1-800-426-2133 (voice) or 1-800-284-9482 (TDD).



The Center of a Home Network

Wouldn't it be neat to network your bathroom scale to the refrigerator, automatically locking the fridge door if your weight exceeds a preset limit? I'm just kidding, although that may not be a bad idea. Here is a sample of what *is* possible with today's technology:

- Adrian, our 9-year-old son, is watching the TV in the den while gathering goodies from the kitchen. When he takes his snack to his room, the TV in his room turns on to the same channel, and the TV in the den turns off. When it's study time, he's not allowed access to the TV at all. The rest of the time he can watch programming that has been selected for him, such as The Discovery Channel. And certain channels, such as HBO or MTV, have been reserved as rewards, to be paid for with earned credits. If Adrian doesn't get home from school on time and enter his security code, we get an automatic phone call.
- During the week, Yvonne and I go to bed about 11:00 p.m. after watching the news. Before retiring, we use a telephone key pad (or intercom with voice recognition) to start a script of commands that turns off the TV, arms the security system, puts the lighting into sleep mode, and sets the thermostat. If Yvonne gets up at 2:00 a.m. to get a cold drink from the kitchen, the security system tracks her movement, and turns lights on in front of her, and off behind her. The computer can determine the difference between Yvonne's movement and that of a burglar, based on IF/THEN/ELSE rules and its understanding of our habits. The same sensors used for automation when we are at home are used for security when we are away, or when a perimeter break has occurred. AWAY is another script that sets up security differently when we leave the house in the morning. VACATION is similar, but simulates a lived-in look.
- In the morning, a second script starts at a pre-set time, turns up the thermostat and hot water heater, turns on the bathroom lights, opens the curtains to let the light in, and wakes Yvonne and me with our favorite music. I respond with a command, "Computer, Access Calendar"; voice recognition software responds to my command to access today's activities, and then "reads" them through the intercom speaker. I might then ask for yesterday's articles about IBM, the status of stocks I'm tracking, or a summary of my net worth.

- I control the operation of my house the same way that I control other PC programs. For example, I might use the mouse, icon objects, and drag-and-drop capabilities of OS/2's Workplace Shell to re-program home automation tasks. First I click on the House icon, which brings up a scanned-in picture of our floor plan. Then I click on the master bedroom, which zooms in with more detail, so I can select both lamps on either side of the bed. The right mouse button shows the functions of the lamp objects in the same way that it shows the functions of all other objects in OS/2. Instead of using a mouse, I could also control my PC or house with a keyboard, touch screen, or voice commands.

The computer now acts as my partner and advisor, letting me spend more time with family while helping me improve business effectiveness. And I have more control of where and when I work and live.

These home automation benefits have long been available for techno-fanatics willing to pay $20,000 to $200,000. Now it is possible, at reasonable prices, to link once separate systems (telephony, security, voice recognition, heating/cooling, lighting and appliance control, audio/visual, etc.) into an integrated whole — a Home Network. And home automation saves money, cutting utility bills an average of 20% to 30%.[10]

If the PC plays a role in home automation today, it is typically just to program a stand-alone controller device and then disconnect. That's because of the relatively high cost of dedicating a PC to control and monitoring functions. But with a multitasking operating system (OS/2) and a PC that is already purchased for other functions, it becomes easier to justify having the PC play a greater role. One advantage of using the PC as home automation controller is the ability to include artificial intelligence features, so your system can learn your habits and act accordingly, making useful suggestions. Another advantage is the ability to access more information (for example, weather and utility rates that may change hourly), so it can better determine the least expensive time to water the lawn or run the washer and dryer.

The computer now acts as my partner and advisor, letting me spend more time with family while helping me improve business effectiveness.

High-Speed Communications

Key to our nation's success in the Industrial Age was a transportation system that moved raw materials to factories and then on to consumers. As we move through the Information Age, our success depends on a communications system based on an "information highway," as proposed by the Clinton Administration. High-speed communications will be one of the most important technologies for the future. It will affect how we live, where we live, and the landscape of our cities, just as electricity did in the early 1900s.

Our grandparents may have had electric lights, but there were few electric motors — nothing to spin the laundry, or run the dishwasher, or play the VCR. So they couldn't imagine how air conditioning and elevators would bring people together into tall buildings. Today, we are just starting to imagine the impact of personal computing and high-speed communications.

The nation is being rewired with fiber optics. When you see cable companies digging up the street, you can bet they are laying new fiber, and the same goes for telephone companies. We expect to see multi-gigabit/second phone lines in the mid-1990s, and speeds measured in terabits/second by the year 2000. (At 1 Tbit/sec, you could ship the Encyclopedia Brittanica in 1.5 milliseconds!)

Interactive TV

The fiber that eventually finds its way into your home will carry all kinds of information services (telephone, newspaper, home shopping, home banking, mail, etc), but the most compelling application is likely to be interactive TV.

As you might imagine, rental companies like BlockBuster Video and networks like CBS and NBC view this as competition and opportunity. But consider the benefits to the consumer:

- Electronic TV Guide: Downloaded to your PC once a week, the electronic TV guide helps you find your way through the greatly expanded collection of programming that has become available. You search through available programs by keyword, and schedule automatic videotaping of your favorites. You'll be guided along by your computer, with new user interfaces that make programming today's VCR seem like programming computers in COBOL, and your PC will learn your preferences and make appropriate suggestions.

[10] "Smart Houses: Getting Switched On," *Business Week*, June 28, 1993, page 128.

- Interactive TV Education: Students can participate in interactive education through their TV, having access to the world's best specialists in their field of study. Teachers can reach more students, and students have access to more teachers and subject experts. Multimedia and the ability to pull the best teachers together electronically can enrich the learning process, and better prepare our children to compete in a global society and at less cost.
- Search, Cut, and Paste: Johnny can search for specific still images or video clips for a book report using keywords and hyperlinks. He then pastes the image or video into his document. His report is submitted electronically, and the teacher clicks on an icon to view the video.
- Just-in-Time Education: You can view portions of how-to videos right when you need them, and without having to view the entire video, just the part about fixing the leak under the sink. If you need more help, you can be connected to an expert through video conferencing.
- Video Conferencing: You initially were excited about the potential need for less business travel, but you discover that the real benefit is your ability to bring collections of experts together more quickly. This gives you a competitive edge — from your home, which is now on the beach or in the mountains. Some of the experts you include in your conference don't speak English, but their PCs translate for them. You realize that you are no longer constrained to hire talent from within a limited geography, but have access to the world. The result is that the nations which succeed in the Information Age are the ones that had vision and invested in infrastructure — "The Information Highway."

At this point, you may say: "Let's get back down to earth! Is all this really going to happen?" Yep... and more. Even now, your mind may be spinning (mine is)!

IBM is committed to industry standards, and currently participates in over 3500 standards committees around the world.

Standards and Regulations

Change of this magnitude brings large challenges, many in the area of standards. IBM is committed to industry standards, and currently participates in over 3500 standards committees around the world. With all of the arguments over standards and who has access to the fiber, the Federal Communications Commission still has not decided who will get the right to bring it into your home, and which services will be allowed on it. The politics are overwhelming, as are the opportunities. At stake are the fortunes of companies and the viability of nations.

Developing Applications with Reusable Objects

Hardware technology is coming at us so fast that one thing is certain: Software will have a hard time keeping up if we develop it like we have in the past. Fortunately, the industry is moving to the use of reusable and interchangeable objects (as in object-oriented programming), much like interchangeable parts for cars. Objects can represent program segments (such as a video player), data files (the compressed video), or hardware devices (for example, a wall switch). You can combine objects to make new objects to perform specific services, such as downloading various pieces of information from PRODIGY each morning, presenting it in the format you like, or making it available for programmed tasks (for example, water the lawn at 4:00 a.m. if it is dry and no rain is predicted).

We'll soon see tools that make it easy for many PC users to create their own applications, simply by dragging objects around on the screen and connecting them. You'll be able to combine your favorite word processor object and favorite spell checker (from different vendors, written in different computer languages). You'll then select a graphics conversion utility, a drawing tool, and a business graphics engine that can be linked to a spreadsheet. With access to hundreds of fonts, and clip art from several types of libraries, you put your presentation together to be shown with a presentation tool from yet another vendor. It all snaps together seamlessly, and you have made your customized version of — Lotus Freelance**, for example. Lotus and WordPerfect** and others will sell class libraries of reusable objects, so you can pick and choose. You'll be able to access objects that are stored on your own system, or ones that are stored on a remote system on a different kind of computer.

IBM has a powerful, open, distributed object strategy for the future, and a defined platform in OS/2 for object exploitation today with the Workplace Shell, System Object Module (SOM*), and Distributed SOM (DSOM*). Our technology is being developed with partners like

Apple**, Hewlett-Packard**, and Sun, is being shared with standards bodies, and is consistent with the Common Object Request Broker Architecture (CORBA) endorsed by the Object Management Group (OMG).

Happy Home-Computing Requirements

This section describes how to implement the dream with the least effort. IBM's vision of the future of home computing isn't much different from that of a dozen other companies. What is different is how it takes you from today's realities to tomorrow's promise. OS/2 is a key part of IBM's software plan for delivering that promise. It improves the quality of the journey by eliminating many of the pains, migrations, upgrades, and relearning that you might otherwise expect.

Multitasking

Because users should not have to turn off their fax and voice-mail applications in order to write a letter, smooth multitasking is the number one requirement for the vision portrayed here. OS/2 offers fast, safe multitasking, so typing is responsive and you don't have to wait for your computer, and so you can make these visions become real.

Compatibility with Your PC Hardware and Applications

Because people don't like too much change, any new operating system must be compatible with existing hardware and applications. For this reason, IBM has tested OS/2 on hundreds of 32-bit, IBM-compatible computers, and offers a money-back guarantee if it won't run on yours, given enough memory and disk. OS/2 comes with more than 260 printer device drivers for all of the leading printers. It supports all of the most popular CD-ROM drives and their associated SCSI adapters. Leading audio/sound adapters are also supported.[11]

OS/2 excels in application compatibility, too, with its ability to run virtually any DOS, Windows, or OS/2 application. It also has a strong evolutionary future that lets you expand your system without constant upgrades to application software.

Ease of Learning and Use

The user interface must be intuitive and easy to use, because the biggest barrier to widespread use of personal computers has been the effort to learn and apply the technology. We've come a long way since the DOS prompt (C:>) with graphical user interfaces. OS/2 goes further still, setting new standards for ease of learning and use with its object-oriented user interface. Objects on the OS/2 desktop (folders, files, printers, disk drives, etc.) act just like everyday objects. To print a file, just drag it over to the printer; to put it away, drag it into a folder; to delete it, drag it to the shredder. OS/2 users *love* OS/2! Here's a typical comment:

"I find this system so convenient and uncomplicated to use that most of my time is spent fighting my seven year-old son for control of my computer. I feel that IBM has once again proven that it is not only the front runner of microcomputer technology, but also the trail blazer of times to come!"[12]

Ease of Installation

New system software should also be easy to install with minimal training. Ideally there would be no training required for family members, and OS/2 lives up to that ideal. It is important, however, to have someone technical enough to take charge of installing and setting up the system for other family members. When installing OS/2 for the first time, some have described the experience like that of moving into a new house — there are always a few things that take a while to find, but the pain of moving is soon forgotten and well worth the benefit.

OS/2 2.1 ships on over 20 diskettes (or on CD-ROM), which seems overwhelming to many potential users. IBM is evaluating various options for turn-key packages for the home markets, recognizing that delivering the vision of this paper requires more computer skill than we'd prefer to have.

Currently, the easiest way to install OS/2 is to buy a system that has it pre-installed. If you are buying from a retail store today, the systems you'll find with OS/2 pre-installed may be IBM systems, but we are now seeing more PC manufacturers willing to pre-install OS/2 upon request, and hope to see this as a standard practice in the future.

Leaving Your PC Up and Running

Rather than turning on your PC, running your application, and turning it off, you might decide to just keep it on with your favorite applications already started and running. This is especially attractive when running a sophisticated system like OS/2 (or DOS with Windows and lots of other extensions), because of the time it takes to boot up again.

Choosing the Location of Your PC

Where you put your computer depends on its intended use and users. Because 75% of PC-owning households are work-at-home house-

[11] Kevin Maier, "What's New in OS/2 2.1," *IBM Personal Software Technical Newsletter*, Issue 1, 1993, page 3.

[12] Source: Donald K. Champine, Security Pacific Automation Company, Inc., Seattle WA.

holds, many people put their PC in a home office. That can be a spare room, a corner of a room, or even a large closet. A home office can provide privacy and a way to hide office clutter, while protecting equipment and work-in-process. And when company calls, just close the door. This works especially well if you are the only person who will use the system, and may be required if you want to take an income-tax deduction for home-office expenses.

If, however, you put your system out in the open (e.g., den or kitchen)[13], and leave it powered on and ready to use, you'll find new uses... and new users — the whole family! This is ideal if your objective is kids' education, family entertainment, managing health and finances, or home automation.

Choosing the Right Hardware

Size: One way to save space and avoid conflicts with home decor is with the new notebook PCs. They can also be moved into a quiet room for privacy, possibly eliminating the need for a dedicated home-office. Besides being portable, they are smaller, quieter, and consume less power than desktop PCs; and they have suspend/resume features. Rather than close your OS/2 applications and turn off the power, you can simply close the cover of the notebook, putting the system into suspend mode and saving energy. Opening the cover brings the system back to life, with all of your applications loaded and running, just like you left them. Newer desktop PCs may have similar suspend/resume features that cause them to use less power during periods of inactivity, and to "wake up" when input is sensed (from keyboard, mouse, fax, etc.).

Many people will choose desktop PCs instead of notebook PCs because of larger hard disks, more expansion slots, or lower cost (especially when fitted with a color monitor). Some will choose to have both, and may even want them to communicate in a network.

Memory and Disk: OS/2 offers a lot of power and function, but requires more memory and disk than native DOS. OS/2 can support simple DOS applications with as little as 4 megabytes (MB) of memory, but Windows users will be more satisfied with 8 MB or more. And OS/2 needs 15 to 40 MB[14] of available disk space for all of its function, on-line documentation, built-in applications, and scalable type fonts. Almost all systems sold today are already OS/2-capable, and some have OS/2 preloaded.

Processor: In his column in *PC Magazine*, August 1992, John C. Dvorak said:

"I was reluctant to move to OS/2 2.0, but now I can't imagine using anything else. If you have the horses, you're crazy not to try it, folks, no matter what they say. It takes 55 minutes to install, and if your hardware can handle it, the software is rock solid, just like the OS/2 nutballs say it is... It's not particularly fun to tell these guys that they were right."

By "horses," Dvorak is referring to memory and disk storage, since OS/2 doesn't have the voracious appetite for processor speed that Windows has, thanks to genuine preemptive multithreading. Processor speed is less of an issue when you don't have to wait for one application to complete before moving on to the next, and when background applications don't interfere with the useability of foreground applications as they do under Windows. While some people always want the fastest computer they can buy, others believe that because of OS/2, the muscle computer could go the way of the muscle car. As Edwin Black said in the November 1992 issue of *OS/2 Professional*:

"Today it's not important how well your automobile runs at 120 MPH, but how well it does at 55. OS/2 will allow productivity to be measured in multitasking versatility, not sheer velocity."

Support: When users run their home office or entire home on a PC, support can become critical, so vendor reputation deserves strong consideration. Now you can buy PCs from IBM at Sears instead of from other manufacturers through the mail.

Backup and Recovery

Your PC is likely the most important piece of equipment in your home office, so take care of it and back up your system faithfully. Neglecting this important rule is common with DOS and Windows users, because when backup is running, nothing else does. With OS/2, it is easier. As

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[13] A computer for the den or breakfast room should be small, quiet, and fit into the room's decor. And a computer used for home automation to save energy should itself be energy-efficient. IBM's new PS/2 E* is an example of the first "green PCs". It consumes just 23 watts of peak power and 16 watts in suspend mode (versus 180 watts for the average PC), so it needs no noisy cooling fan. It comes with a 10.4-inch flat color display (active-matrix LCD, 256-color VGA), and can operate vertically in a bookshelf or be hung on the wall. And it's made of recyclable materials!

[14] Two products have been announced that support "on-the-fly" disk compression: Stacker* 2.0 (by Stac Electronics) and DCF/2** (Disk Compression Facility for OS/2, by Proportional Software). Disk compression of up to 50% is possible. This means that OS/2 might take just 8 to 20 MB, and all other applications and files would be compressed as well. The difference between the two packages is that Stacker compresses the entire disk partition (the easiest method), while DCF/2 lets you tune performance by choosing what is compressed (fastest, but slightly more complex). Stacker was designed for DOS and was ported to OS/2, while DCF/2 was designed for OS/2 and supports both FAT and HPFS file systems.

expected, OS/2 comes with backup and restore utilities. They can be used to back up parts of your system while you work actively on other parts. Or, you can choose add-on products that make backup even easier and support a wide variety of devices, such as diskette, 4mm Digital Audio Tape, 8mm tape, and 3.5-inch rewriteable optical disks.[15]

Don't Forget Insurance!

Another way of protecting yourself and your home-based business is with insurance. Homeowner and renter policies can cover your computer equipment and software for a modest additional premium. They are often limited to $5,000 or $10,000, which should be enough for most home offices but may may not be enough for a sophisticated one, including software. In any case, check with your insurance company.

Preparing for Scheduling Conflicts

You can encourage PC use and increase PC benefits by matching convenience with the excitement and power of OS/2. Even small families, however, should prepare for scheduling conflicts as described by OS/2 users. They say it's like a late-model sports car with an innovative new body on a racing chassis with an awesome new turbo-charged engine. As such, it surpasses the popular windowing systems such as Microsoft Windows** that simply put a new body over DOS's Volkswagen engine. When you get familiar with working with OS/2, past the "ah-ha" stage, you too will find that OS/2 is a dream to drive. Just like the conflict that arises when your son wants to borrow your car but you need it to run errands, you should expect scheduling conflicts with your PC. You may need to plan your home-office time so it doesn't conflict with school and entertainment time (or even include a second PC in a network for your kids and spouse):

"I write to you now as a last resort. You see, I have lost my boyfriend to OS/2. For the last two weeks, he has been locked in the computer room as if he were a mad scientist on the verge of a momentous discovery. I knock, I pound, I whimper into the keyhole, I slide notes under the door; and to no avail... I could hear him cackling with glee, and often I heard awe in his voice that sounded as if he were witnessing the second coming... I must go in after him. Clearly this man of mine cannot help himself. The temptation of OS/2 is too great. He is hooked, and I am the only chance he has left... If you can't beat em, join em!"[16]

I knock, I pound, I whimper into the keyhole, I slide notes under the door; and to no avail...

Who Works at Home?

When the bureaucracy of a large company makes it difficult to buy new software, or when users don't have time to experiment, the home PC takes on a new and hidden role — as a place to learn new computer skills and to try out new software applications. Even though IBM's heritage has been solving the business computing needs of large corporations, there is a need to understand the interests and motivations of the home worker. This is partially because user opinions and preferences that affect corporate standards often start at home. But interest in this market isn't just limited to its effect on large corporations. It's an exciting and growing market where IBM can apply leadership technologies.

The following is from the seventh survey of 2,500 households done by Link Resources.[17] It covers the work-at-home market segment, but it ignores other home uses of PCs.

New Entrepreneur: (12.1 million individuals in 9.6 million households) — These self-employed, full-time workers depend on the business they run out of their home for their primary income. For this reason, they tend to spend more on home PCs, fax machines, and telephone services than do moonlighters and corporate homeworkers. Owning the right home-office equipment is important, and if they believe OS/2 or any other new product will help bring in more cash, they'll buy.

A subset of New Entrepreneur is people whose home-based business is fulfilling a lifelong dream. Because making money is relatively unimportant to them, they tend to buy equipment impulsively, with little regard to its financial justification.

Contributor: (11.7 million individuals in 9.2 million households) — This segment includes people who are part-time self-employed, moon-

[15] Sytos Plus**, by Sytron Corporation, is a complete OS/2 backup solution capable of handling HPFS files, long pathnames up to 260 characters, and Extended Attributes of OS/2 files. A companion product, Sytos Rebound**, extends recovery even further. To find out more, call 1-800-3IBM-OS2 (1-800-465-1234 in Canada).

[16] L. Christian Candelmire, University of California, Berkeley.

[17] Thomas E. Miller, "Home Office Overview," Report #01358, Link Resources Corp. (a New York-based research and consulting firm), March 1993.

lighting, or doing freelance work. They contribute to family income and increase in numbers during hard economic times in order to help make ends meet. With less earning power than New Entrepreneurs, Contributors tend to buy more portable PCs, but they invest more cautiously.

Corporate Eager Beaver: (8.4 million households) — These days, many corporate employees bring work home from the office in the evenings or on weekends so they can compete with their peers while spending more time with their family. Link Resources reports that 54% of them have a PC at home, but since they also have access to equipment at the office, they tend to buy only the essentials for home. Although some corporations help Eager Beavers fund equipment purchases, most are on their own.

A subset of Corporate Eager Beavers is principals and senior executives with large corporations. Financially well off, they occasionally work from home rather than in the office for reasons of convenience, productivity, and life style. Although spending levels may vary by industry, PCs and advanced communications are essential.

Telecommuter: (6.6 million individuals in 4.9 million households) — More and more companies are allowing employees to work at their homes at least one day a week. This cuts down on travel time, improves productivity by eliminating office distractions, and lets the company keep valuable employees (such as new mothers) who might otherwise quit. By supporting telecommuting, companies may also have access to a larger skill base, because they aren't limited by geography. They often save on expensive real-estate costs, and can support a larger customer base with fewer offices. With a strong need to stay in touch with the company office and customers, communications is extremely important.

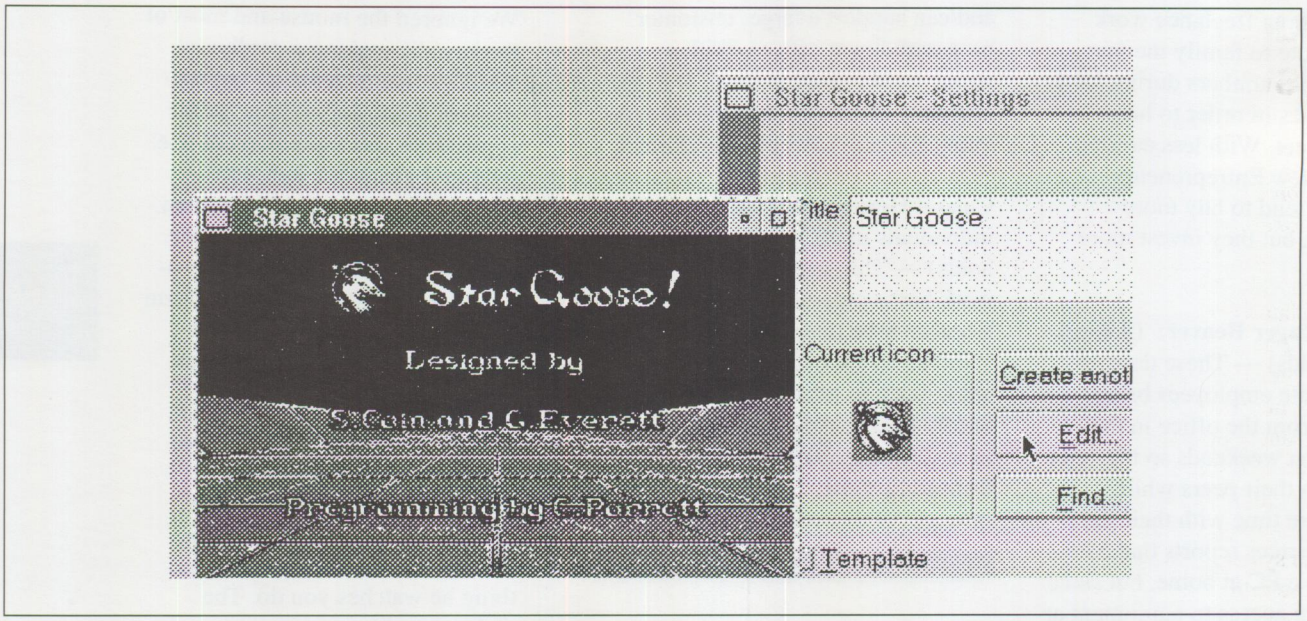
Casual Homemaker: (77.3 million individuals in 48.7 million households) — This larger group brings work home only occasionally. Because their interest in a home PC is driven by motivations other than work (such as kids' education or family finance), they are not included in most of the analysis of the Link Resources study.

At 3 or 4 years old, kids can manipulate the mouse better than many adults.

Practical Tips for OS/2 Users at Home

Most PC users agree that OS/2 sets new levels in ease of learning and use (especially for kids), and is fairly forgiving. It is still wise, however, to have someone set up the system for the rest of the family. Here are some tips that I've learned from experience and from talking to others:

- How old should children be to use OS/2? I started mine at two years old with Early Games by SpringBoard Software. The first topic was to recognize shapes of numbers (6 versus 9, 3 versus 8, 1 versus 7) and their names (I'd pronounce each new number when it appeared). Next was to recognize values (9 is larger than 6) by counting the number of blocks and choosing the corresponding key. We ignored the mouse and most of the keys by making a cardboard template that covered all but the numeric keys, and we started the application and supervised its use. At 3 or 4 years old, kids can manipulate the mouse better than many adults, and can turn on the computer and start their own programs. OS/2 makes a fine platform for kids, especially if someone else sets up the system for them.
- Watch out for miscellaneous objects inserted into the diskette drives. Watching me insert diskettes, my son inserted keys, coins, candy, and other objects. Assume that he'll try to do anything he watches you do. The diskette problem went away with parental guidance and computer literacy (age 3 or 4 in my son's case).
- Small children make wrong choices on purpose (to see what happens), like holding down the keys until the keyboard buffer fills and the system beeps endlessly. They aren't intimidated by computers and icons but tend to avoid menus they have to read.
- Get rid of the shredder. Put it in the "Dad" folder, or delete it completely. You don't need it anyway, because the right mouse button menu includes a "delete" function.
- Hide things in the OS/2 System Folder that you don't want the rest of the family to use, such as Shredder, Templates, and other items that the install process puts on the desktop for you. It gets them out of the way, and makes the desktop cleaner.
- Set up all the folders for the kids and spouse with shadows of the program objects. This way, even if they delete the shadow object, they won't delete the original.



Icon Be Creative, with Cut-and-Paste into the Icon Editor

- Have the system come up with the Games folder open, and set it up with icons that children know. To make custom icons, I "window" the DOS session, "mark" and "cut" out a representative graphic, and "paste" it into the icon editor.
- Make unique folders for each child with attractive icons that let each child know that this is the part of the computer he or she is allowed and encouraged to use. Put the icons in an obvious place, and make the resulting folder large enough to cover most of the desktop.
- Teach your child how to "shut down," and remind the child when he or she forgets. Some parents have even made a "turn off the computer" icon. At risk is that some of your system changes may not be saved, or that disk output may not have completed yet. Shutting down is most important for users who have chosen the High Performance File System (HPFS), but it's not that big of an issue to wait while recovering the Swap file if young ones do forget — they quickly learn the rule!

  Chuck Brazie agrees that shutting down is not a problem. "My 4-year-old likes Reader Rabbit, Mixed-Up Fairy Tales, the puzzle applet, and even playing with Corel Draw. She can shut down the system like a champ, and she waits for the 'little box to turn into the big box' before powering off. The 10-year-old likes Operation Neptune, the Carmen San Diego Series, Mario Teaches Typing, Oregon Trail, Mahjongg, and even experiments with BASIC and REXX* programs."
- Protect your .INI files. Gene Fine warns that OS/2's ease of use can cause curious side effects. "My daughter gets a blast out of bringing up the scheme palette, with the help of my son, and changing the colors to those she likes. One night I booted a screen with pastel blues, pinks, and yellows, and large, weird fonts (yuk!)." This can be avoided by maintaining and restoring backup copies of .INI files (for example, add an XCOPY of your .INI files in STARTUP.CMD). There are also free utilities available on dial-up bulletin boards that protect against any change in the Workplace Shell.
- Pat Hammond uses multiple icons and folders to encourage shared use. "One of the games that our 6-year-old really likes is one of the coloring programs. I have set it up so two players can take turns. All it takes is Alt-Esc to switch between sessions. I'm not sure if she can set this up by herself or not, but once it is up, she can handle the switching. I have separate directories for each child's pictures, and separate program icons that point to each directory."
- One of the really nice things that can be done with OS/2 is setting up *associations*, which are special links between program objects and data-file objects. For example, you can link the program object for a spreadsheet to every spreadsheet object. Associations can be made

by file type or file name (including wildcards). You can set up *.PCW for PC Write and *.WKS for spreadsheets. Now all the user has to do is double-click on the data file, and the system opens the program with data file already loaded — true object orientation.

Each family member can have a folder with private data files, and won't have to worry about which command or path is needed to start an application. To work on a letter file, simply double-click on the document. To work on a spreadsheet, double-click. Similarly, *.X10 can be used for appliance controllers to let you "click" a lamp on or off.

- From Ray Dixon: "The AUTOSTART statement will allow you to prevent things from being automatically restarted at boot time. Say your son had about ten games going under DOS full screens, and he didn't exit them before doing a shutdown. When you reboot, if AUTOSTART=PROGRAMS is set, then all ten copies will be restarted. You may not want that, because it can cause your boot time to seem longer. To prevent this, remove the PROGRAMS from the AUTOSTART statement in CONFIG.SYS.":

```
SET AUTOSTART=PROGRAMS,
TASKLIST,FOLDERS
```

OS/2 has the power and flexibility to work like you do, so you'll likely discover your own setup preferences. If you discover some interesting tips of your own, please forward them to the author.

Can't Microsoft Windows Do That?

Yes — and no. Windows 3.1 can likely do any one of the applications described in this article, but it has difficulty doing several at the same time.

Word Processing: Long-running tasks can interfere with keyboarding, making text entry painfully slow. Examples include distributing a fax, formatting a diskette, backing up your system, downloading a file from a BBS, or simply printing. While performing any of these tasks, delays in Windows multitasking can cause characters to display several seconds after you enter them, if at all. The user interface becomes completely unresponsive, and you give up and decide to go out for dinner. With OS/2, you can have many active tasks running, and the user interface still responds like like a champ. You keep on typing, and admire your productivity improvement.

It has been reported that Windows users tend to get used to re-booting and losing data, but OS/2 users often run for weeks or months without even shutting down.

Spreadsheets: Your PC-attached CD-ROM drive is playing stereo music through the sound card of your PC when you start up an Excel** macro. You wonder why the sound stops (and starts, and stops again...). It's because Windows does not multitask as well as OS/2. With OS/2, you could have several audio sources piped through the same or multiple sound cards while other tasks are running, and the music never skips a beat.

Games: Your 12-year-old son is playing Space Quest V, a DOS game with impressive graphics, animation, and digital sound. The phone rings, and it's an incoming fax. While receiving the fax, the responsiveness of the game goes to pot, and your son hasn't a clue why. He starts messing around with system settings, but he finds that difficult and slow, so he re-boots the system. So much for your fax.

General Protection Fault: You've been working for hours on a document, spreadsheet, or presentation with graphics when you start another task and get the infamous General Protection Fault. This Windows memory protection feature warns you that a program erroneously accessed memory outside of its own address space, but this time it doesn't give you the advertised option of closing that one application, because some system control blocks were changed. The system is locked up now, and your only option is to re-boot without the ability to save your work. It has been reported that Windows users tend to get used to re-booting and losing data, but OS/2 users often run for weeks or months without even shutting down. OS/2's crash protection is an advantage for both home and enterprise environments.

As a DOS extender, Windows 3.1 adds some amazing new function to the 13-year-old DOS that it relies on for input, output, and other system functions. OS/2, on the other hand, is a replacement for DOS (and Windows). OS/2 was designed for today's multitasking environments, and provides its own system services. It generally runs Windows applications as fast or faster than Windows does, and runs them with more safety. Unlike Windows 3.1 or Windows NT**, OS/2 lets Windows users run Standard Mode and Enhanced Mode

Information Sources

Telephone: You can get more information about OS/2 by calling IBM at 1-800-3IBM-OS2 for a free demo diskette; you can also use this phone number to order your copy of OS/2. They can also refer you to a local PC dealer equipped to give you a demonstration.

Where to Find OS/2 Applications: The *OS/2 Applications Solutions Directory* lists thousands of OS/2 applications from independent software vendors. To order your copy, call 1-800-READ-OS2.

For Independent Vendors Providing Products and Services that Support OS/2: To order the I.V. League Catalog, call 1-800-342-6672.

IBM CourseWare and Education: Skill Dynamics*, an IBM Company, call 1-800-IBM-TEACh, ext.137.

Fax: Call 1-800-IBM-4FAX and request an index of documents. Use your touch-tone phone to request by document number.

Books and Magazines: Over 35 OS/2 books are in print, with three of the top ten computer books being about OS/2. They range from a paperback-sized *10-Minute Guide to OS/2 2.1* to the larger *OS/2 2.1 Unleashed*, which is over 1,000 pages. Magazines include:

- *OS/2 Professional*, by I.F. Computer Media. Call 1-301-770-4OS2 to subscribe.
- *OS/2 Monthly*, by JDS Publishing. Call 1-800-365-2642 to subscribe.
- *OS/2 Magazine*, by Miller Freeman. Call 1-415-905-2200 to subscribe.
- *OS/2 Developer,* by Miller Freeman. Call 1-800-WANT-OS2 to subscribe.

Home Automation:

- *Electronic House* magazine, by E. H. Publishing. Call 1-405-624-8015 to subscribe.
- *Understanding and Installing Home Systems*, by David Gaddis, ISBN: 0-9632170-0-3.
- *Approaching Home Automation - A Guide to Using X-10 Technology*, by Bill Berner and Craig Elliot, ISBN: 1-881911-00-4.
- *X-10 standard*, X-10 (USA) Inc., 91 Ruckman Rd., P.O. Box 420, Closter NJ 07624, 1-201-784-9700.
- *CEBus* standard, EIA Consumer Electronics Group, 2001 I St. n.w., Washington DC 20006, 1-202-457-4975.
- *SMART HOUSE standard*, Smart House Limited Partnership, 400 Prince George's Blvd., Upper Marlboro MD 20772, 1-301-249-6000.
- *Echelon standard*, Echelon Corporation, 4015 Miranda Avenue, Palo Alto CA 94304, 1-415-855-7400.

On-Line Information: On-line documentation contained within OS/2 2.1 is so extensive that, even compressed, it takes up 2.5 megabytes of your hard disk. If it were printed, it would be over 2,000 pages! With such a vast library of information available, IBM has taken great pains to make it easy to access and navigate through. Helps are context-sensitive, and often contain hyperlinks to more detail if needed.

This is just a small subset of the many sources of information about OS/2.

Ordering Information: The suggested retail price of OS/2 is $249 ($219 for CD-ROM version), including all of the functions of DOS and Windows and more. Existing DOS, Windows and OS/2 users can upgrade for just $179 ($155 for CD-ROM version) by calling 1-800-3IBM-OS2. And OS/2 users can send in a rebate coupon worth $30, getting the price down as low as $125!

Feedback

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Fax, 1-512-823-2733 or Tie Line 793-2733
(Tie Lines are internal to IBM)

IBMMAIL: USIB5QD8 at IBMMAIL
Internet: WCASWELL@VNET.IBM.COM
PROFS: WCASWELL at AUSVM1
IBM Forum: OS2HOME on IBMPC (IBM internal forum)

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applications concurrently, taking the full screen or participating seamlessly with other windowed applications on the desktop, and running in a separate session for maximum protection or with other Windows applications in a single session to conserve system resources. Running DOS or Windows applications under OS/2 has many other advantages over running them in their native environments. Most of those benefits won't be discussed in this article, however, except to contrast with what Windows did to extend DOS.

Memory Manager: Windows provides a memory manager function that enables DOS applications to access more than 640 K of memory. OS/2, on the other hand, doesn't have to contend with the outdated memory scheme found in DOS, which requires that programs be written in 64 KB segments (the register size of early Intel processors). OS/2 improves support for DOS applications with up to 32 MB of EMS/XMS memory and 512 MB of DPMI memory for each application. And OS/2 applications are free of page segments — they can address memory contiguously, and use 32-bit instructions that exploit your 32-bit hardware.

Graphical Program Launcher: Windows adds a graphical user interface (GUI) to DOS, but OS/2 advances the user interface a generation beyond the GUI found in Windows 3.1 or Windows NT. OS/2 has an object-oriented interface, the Workplace Shell, where each icon on the "desktop" represents an object (printer, disk drive, program, folder, file, etc). The metaphor is more lifelike, so new users find it much easier to learn. Even experienced Windows users find OS/2 easier to use, because most operations can be completed with one mouse click. To print a document, simply drag to the printer instead of (in Windows) opening the program manager, then the word processor, then selecting File and Directory and File Name just to open the document, and finally selecting Print and Print Location to finish the printing task. (And don't forget to close the word processor.)

Windowing Task Selector: Windows 3.1 lets users switch back and forth between running applications, even between DOS and Windows applications, that appear in overlapping windows. It also includes ways of exchanging information, with Cut-and-Paste, DDE, and OLE. But multitasking under Windows is limited, because it sits atop DOS, which was never designed to run more than one thing at a time. DOS suffers from a single I/O buffer that forces all I/O operations to be serialized (one at a time), and since Windows relies on DOS for its I/O, Windows suffers too. OS/2, on the other hand, was designed specifically to support preemptive multitasking. This allows applications to better share system resources and all run at the same time. OS/2 can also support several overlapped I/O operations due to multiple, shared I/O buffers.

What are Your Growth Options?

There is one last issue with Windows: Where do you go from here? Microsoft is already talking about Chicago (a code name for Windows 4.0), which is not expected until sometime in 1994. Chicago hopes to solve some of the problems Windows users have today, by bypassing DOS completely, doing its own I/O, and by adding support for 32-bit applications. To exploit Chicago, you will likely have to upgrade all of your Windows applications again, as you've done in the past going from one release to another.

With OS/2, you can run your 16-bit DOS and Windows applications, and add new 32-bit applications when you are ready. As in the past, when moving to new OS/2 releases, your old applications should still run fine, because of IBM's long-term commitment to protecting customer investments in hardware, system software, and applications.

Wayne Caswell *is a Program Manager in IBM Personal Software. His responsibilities include developing and communicating marketing strategies for OS/2 and other IBM PSP Products. He has spent the last 12 of his 24 IBM years with end-user computing — even before the PC! OS/2 will be at the center of a home network, in a new home Wayne is building in Austin, that is designed to prove the value of the applications he writes about. Wayne has a BA in management technology from The American University. He can be reached via Internet at wcaswell@vnet.ibm.com.*

A Visit with OS/2: More than Just a Pretty Face

George Palma
Sacramento, California

Reprinted with permission from the May 1993 issue of Sacra Blue®, *the official monthly newsletter of the Sacramento PC Users Group, Inc.*

Many OS/2 users may never need (or want) to look beneath the pretty face of the Workplace Shell (WPS), which is the graphical user interface of the operating system. However, to understand many of the intricacies of OS/2 and to get a feel for its power, I think it is helpful to have some knowledge of the command processor, the command-line interface, and the nature of the multitasking environment that is available with OS/2.

The OS/2 Command Line

The OS/2 command processor is called CMD.EXE, and it performs the same types of functions that COMMAND.COM does under DOS. In fact, the OS/2 command-line interface is not very different from its DOS cousin's.

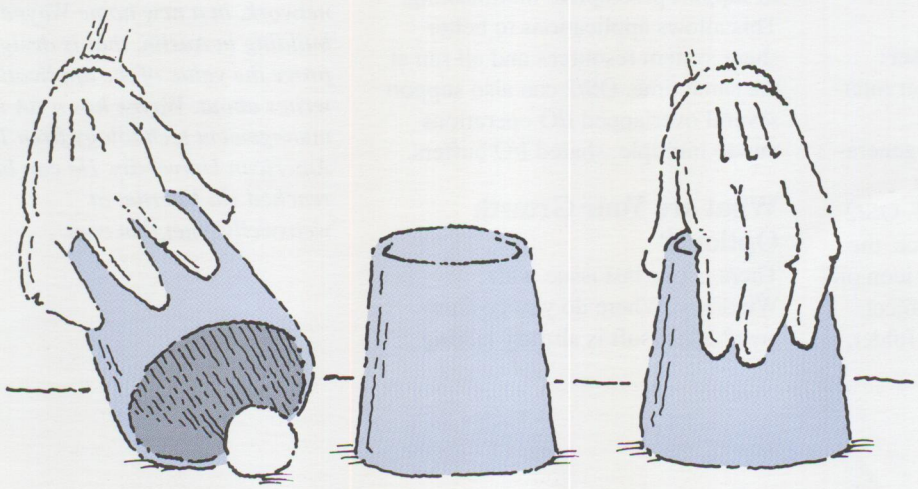
Essentially, all of the commands familiar to DOS users are available to OS/2 users, although in many cases there are differences in the options or switches. For example, the OS/2 version of RENAME can rename a directory or a file, whereas the DOS version can rename only files.

OS/2 has added several commands that are not found in DOS. For example, MOVE performs a destructive copy operation. PICVIEW displays a special type of high-resolution picture called a metafile. VIEW is called to read an information file (with file extension .INF) that stores on-line documentation. Once the .INF file is opened by VIEW, a table of contents is displayed, and the file can be searched by keywords. It can also be indexed, and selected parts of the file can be printed.

SPOOL can be used to redirect the output of logical devices. For example, SPOOL /D:LPT1 /O:LPT2 redirects print data destined for LPT1 to LPT2 instead. On my system, I have my printer set up as LPT1 and my fax/modem configured as LPT2. By using SPOOL, I can print a file and either have it printed on paper or sent as a fax.

OS/2 also provides greater flexibility in executing commands from within batch files. However, as powerful as batch command processing has become under OS/2, I have pretty much abandoned batch command language for getting things done. This is because of the availability of REXX, which is an integral part of the operating system. It can do anything a command language can do, and much more. The use of REXX procedures makes automating complex jobs simple and fun.

I/O redirection and piping are fully supported under OS/2. The use of the "&" character between command statements performs command concatenation. For example, the following command entered at the command line will: change the directory; redirect the output of the filtered directory listing to the specified file;



print the file; and delete the file after printing it.

```
CD \ASCII & DIR *.DOC > DOC.TXT
& PRINT DOC.TXT & DEL DOC.TXT
```

Command editing and recall is made reasonably easy by the KEYS command, which is similar to the DOSKEYS program under DOS. When KEYS ON is entered at the command line (this is the default), a full complement of editing keys are made available, as shown in Figure 1.

Home	move cursor to beginning of line
End	move cursor to end of line
Insert	toggle insert/overstrike modes
Delete	delete character under cursor
Backspace	delete character to left of cursor
Esc	erase entire command line
Left Arrow	move cursor to left
Right Arrow	move cursor to right
Ctrl+Home	delete line to left of cursor
Ctrl+End	delete line to right of cursor
Ctrl+Left	move left to start of word
Ctrl+Right	move right to start of word
Up Arrow	move up through command history
Down Arrow	move down through command history

Figure 1. Editing Keys

The command history is a last-in, first-out text buffer that contains all commands (up to 64 KB) entered during a session. Recalling a command used earlier in the session is as easy as pressing the Up Arrow or Down Arrow key until the desired command appears on the command line.

When an OS/2 command-line session is started, CMD.EXE looks for an optional file named STARTUP.CMD in the root directory of the boot drive. This file is analogous to the AUTOEXEC.BAT file found with DOS, and is used, in part, to set up the environment for the session, to launch programs, and to perform other tasks before the OS/2 command prompt appears. Of course, the OS/2 prompt itself can be customized using the SET PROMPT command in the CONFIG.SYS file, which does many of the tasks generally done by the AUTOEXEC.BAT file under DOS.

CMD.EXE executes its own internal commands such as DIR, COPY, and TYPE, and treats as executable any file that ends with one of the following file extensions: .EXE, .COM, .BAT (a DOS batch file), or .CMD (an OS/2 batch file or a REXX procedure file). It searches subdirectories specified by the PATH statement in CONFIG.SYS for a command file. If an .EXE or .COM file is a DOS program, then the OS/2 session opens a DOS session to run the program. Upon completion of the program, the DOS session is closed, and the user is returned to the OS/2 system prompt.

Command processors from independent software vendors make the OS/2 command-line interface even friendlier. JP Software's 4OS2.EXE (a companion to their 4DOS replacement for COMMAND.COM) is the one I use. Both 16-bit and 32-bit versions are available.

Multitasking: Sessions, Processes, and Threads

Thus far, it may seem that OS/2 is a souped-up version of DOS — perhaps DOS 6 has added some of the features discussed above (I'll never know) — but nothing could be farther from the truth. The real power of OS/2 lies in its multitasking capability.

The DETACH command provides a good example of one level of multitasking, and provides an understanding of the difference between a *session* and a *process*.

Let's assume that I have opened an OS/2 command-line session, and that I have written a batch file named SCAN.CMD. This file calls a virus checker from a write-protected diskette in drive B: and scans a subdirectory of my hard drive for viruses. The directory to be scanned has to be specified as a command-line argument when SCAN is called (e.g., `SCAN C:\DOWNLOADS`). As the files in the directory are being scanned, the progress of the virus checker is reported by a text output to the video display.

Of course, I could do without the display, and redirect the program's output to a text file, by entering the command:

```
SCAN C:\DOWNLOADS > VIRUS.TXT
```

I could review the results of the scan later by examining this file. If I enter the command this way, the batch file has the full attention of CMD.EXE, so that I do not have use of the command line until after the process of scanning is complete.

This is the situation that exists under DOS. However, under OS/2, I can detach this process by entering the following command:

```
DETACH SCAN C:\DOWNLOADS >
VIRUS.TXT
```

When I do so, I am informed that "The Process Identification Number is 94" (or some other number), and the OS/2 prompt returns immediately. The process of scanning has now been detached with its own command processor, and I am free to enter commands while it is running. As long as a process does not require interaction with the keyboard, mouse, or video display, it can be detached. Multiple processes can be detached and running at the same time.

I could, if I desired, detach my SCAN program to scan each of several directories. Within a single OS/2 *session*, I would have multiple *processes* running simultaneously and independently. When you realize that I could also have multiple sessions running at the same time, each with multiple processes active, the power of OS/2 becomes clear.

A multithreaded program would be able to detach the search-and-replace thread and let me do other things while it was running.

The degree of multitasking does not end with multiple sessions and multiple processes. OS/2 is also *multithreaded* as well. A thread is simply a detachable procedure within a process. An example of a single-threaded program will clarify the notion of threads.

As I am composing this document, I decide that I want to find ever instance of "OS/2 2.0" and change it to "OS/2." This is quite simple using my word processor's search-and-replace function. However, while the search-and-replace activity is under way, I cannot enter text, print, or do anything else with the word processor. Because it is a single-threaded program, I have to wait for one thread to end before the next can begin.

This is not the case with applications written for OS/2 as multithreaded. In my example, a multithreaded program would be able to detach the search-and-replace thread and let me do other things while it was running. A well-written multithreaded application will truly increase the user's productivity because it reduces the time spent waiting.

One of the things I really enjoy about OS/2 is the ability to switch quickly between modes of working with the operating system. I usually work in the WPS, but my command-line session is always just two mouse clicks away, and I still use it often for certain tasks. To me, this is an ideal situation.

George Palma *is a neurologist in private practice in Sacramento, California. He is an active member of the Sacramento PC User Group, and he began writing articles about OS/2 after installing version 2.0 on his computer in March 1992. Dr. Palma earned his M.D. degree from the University of California at Davis in 1978. He can be reached via fax at 1-916-961-1507.*

OS/2: Productivity without Corruption

Pete Norloff
Rockville, Maryland

Reprinted with permission from the June 1993 issue of Monitor, *the monthly magazine of the Capital PC User Group.*

Since this is the first of my columns to appear in *Capital PC Monitor*, perhaps a short introduction is in order. Some may recognize my name from the Fidonet BBS network, or from my OS/2 Shareware bulletin board system in Fairfax, Virginia.

I've been working with OS/2 since Fall 1989, when the company I was working for decided to use it as the host operating system for a direction-finding and vehicle-localization system. Being modestly well-versed in DOS, and suddenly plunging into OS/2, I started gathering all the information I could find about the operating system, and seeking resources for guidance and advice. This led me to the Fidonet network and to the Capital PC User Group, where I found a number of other people who were excited about the product and happy to help another newcomer. With a lot of help from user group members, from people on BBSs around the world, and a lot of good old-fashioned playing, I got a pretty good education about OS/2.

Around March 1990, I started the OS/2 Shareware BBS. While keeping the BBS up to date, I've collected quite a lot of OS/2 shareware, and have posted it for others to come and get. There are quite a number of interesting, useful programs available on my BBS. While I certainly cannot claim that I have played with them all, I am fairly familiar with a lot of the programs.

I was working on several things the other day, and with no effort at all I found myself really taking advantage of the capacity of my computer system. I've been working on an OS/2 FAT optimizer (defragmenter) program, and have been testing it on my machine. I started an optimization run against a 150 MB SCSI disk that I formatted as FAT for the test. With that running, I started up my SLIP connection to Internet**, connected to ftp-os2.nmsu.edu, and started copying several megabytes of OS/2 files using FTP, IBM's TCP/IP, and David Bolen's SLIP driver.

It was getting late in the day, so I decided I should start a backup. I started the NovaBack software package and was backing up the 150 MB of local data along with the 850 MB or so that are on the BBS disk attached via Ethernet** and IBM LAN Server 2.0. This was all being backed up to a 2 GB Archive DAT drive. With these things running, and requiring no more attention from me, I started cleaning up my desk.

There were some unlabeled floppies accumulating, so I started checking them, and found several that could be put back into the blank floppy

drawer. I started formatting the first of three 1.4 MB floppies. So, there I was with nothing to do again.

I already had a disk optimization running against a medium-sized SCSI disk, a SLIP connection transferring files from New Mexico to Virginia at a little better than 1 KB per second, a tape backup transferring data across the LAN to tape at about 20 MB per minute, and a floppy format running. So I decided to start up a game of Mah Jongg.

The really great thing about all of this is not so much that I was able to do it because of OS/2, rather that I was able to do it without worrying that one or more of these things would corrupt the other tasks. All of these tasks were running on a 486/50 with 16 MB of memory, but there were no capacity problems — the CPU usage was running between 20% and 30%. Also of note is that this was all running under the beta version of OS/2 2.1.

Users of other systems cannot fully comprehend the value of the confidence gained from using OS/2. From what I've observed, people using DOS and DOS/Windows will tell you that everything they are using works great, and that they don't have any problems with their systems. What they don't mention, though, is that they often end up rebooting several times a day. This, unfortunately, is so normal to users of these systems that they don't see it as unusual. This is one of the concepts people need to understand before they can really appreciate the value of OS/2.

With the arrival of OS/2 2.1, OS/2 has another chance to become a major player in the operating system market. We may be in luck, now that Microsoft has sold the computing public a bill of goods with NT, and seems to be back-pedaling very rapidly on the promises they have made. Anyone who has decided that they want the features Microsoft has been promising will have to take a good look at OS/2 as an alternative. Ninety-nine percent of the Microsoft promises that have any impact on mainstream computer users are available today in OS/2 — a stable package that takes advantage of the current installed base of hardware, and includes strong support for almost all existing applications.

Users of other systems cannot fully comprehend the value of the confidence gained from using OS/2.

It's interesting to observe that when OS/2 was the top end of the PC operating system market, and Windows 3.0 came out, Windows became the winner because it ran on existing hardware (it would run on 8088-based machines, and machines with only 1 or 2 MB of memory), and it did something that everyone wanted to be able to do: multitask DOS applications. It didn't do multitasking very well, but it did work most of the time. OS/2 required a 286 and at least 4 MB of memory, and even then it would run only one DOS application at a time. And when you switched it into the background, so you could run OS/2 applications, the DOS application stopped running.

Now that Microsoft is touting NT as the new top end, the same issues that historically made large numbers of people move to Windows may make people move to OS/2. From all reports, NT will require at least twice as much memory as OS/2 does, and it's not going to be able to run many existing DOS and Windows applications. That pretty much kills the advantage of multitasking DOS apps if the apps won't run at all. The fundamental design of the built-in security will keep people from doing many of the things that they are used to doing. I expect Microsoft to release a new NT about a year after the initial release (perhaps in 1995), which will have all the security functions removed in an attempt to regain some of the market they stand to lose to OS/2.

Pete Norloff owns Norloff Computer Consulting, and is SysOp of the OS/2 Shareware Bulletin Board System in Fairfax, Virginia. He also works for LC Technologies on computer systems that are primarily for disabled people. Pete can be reached via CompuServe at 70324,2146. The phone number for his BBS is 1-703-385-4325, and his voice mail phone is 1-703-385-7133.

OS/2 2.1 Technical Update Part 2: WIN-OS/2 3.1

This article is excerpted and adapted from the OS/2 2.1 Technical Update, *one of a series of Red Books published by the IBM International Technical Support Center (ITSC) in Boca Raton, Florida. The IBM order number for this publication is GC24-3948. Part 1 of this article appeared in Issue 1, 1993 of* IBM Personal Software Technical Newsletter.

WIN-OS/2* 3.1 Support and Enhancements

OS/2 2.1 combines the ability to run Windows 3.1 applications with the advanced operating system benefits of OS/2 Version 2. It achieves this by providing an enhanced WIN-OS/2 3.1 environment.

The WIN-OS/2 3.0 support provided in OS/2 2.0 was a major leap forward, and enabled a large number of Windows applications to be run alongside OS/2 and DOS applications on the Workplace Shell desktop.

The aim of the improved WIN-OS/2 3.1 support in OS/2 2.1 is to provide an advanced environment in which to run Windows 3.1 applications:

- Most Windows applications will run, including those that exploit Windows 3.1 features such as Object Linking and Embedding (OLE).
- Performance is comparable to the Windows 3.1 environment.
- Windows applications fit seamlessly alongside DOS and OS/2 applications on the Workplace Shell desktop.
- Clipboard and DDE data exchange facilities are available between Windows and OS/2 applications, and have good performance and ease of use.
- The extra benefits of OS/2 Version 2 (such as multitasking and protection between applications) are available to Windows applications running under OS/2 2.1.

The WIN-OS/2 3.1 support in OS/2 2.1 replaces the WIN-OS/2 3.0 support in OS/2 2.0. Although real-mode Windows applications are no longer supported under either Windows 3.1 or WIN-OS/2 3.1, most Windows applications have now been updated for Windows 3.1. Figure 1 shows several WIN-OS/2 3.1 windows running under OS/2 2.1.

Windows applications fit seamlessly alongside DOS and OS/2 applications on the Workplace Shell desktop.

Summary of Enhancements: WIN-OS/2 3.1 meets the above objectives, by merging the Windows 3.1 code enhancements with the modified WIN-OS/2 3.0 code, by adding extra seamless display drivers and printer drivers, and by tuning and redesigning various components of WIN-OS/2 in order to increase performance.

WIN-OS/2 3.1 includes the following enhancements:

- Windows 3.1 standard-mode environment
- WIN-OS/2 3.1 performance improvements
- Enhanced compatibility mode environment, which enables major Windows enhanced-mode applications (such as Mathematica for Windows and Omnipage Professional**) to run
- Object Linking and Embedding support
- Windows audio multimedia support
- Addition of the Level 2.5 Adobe Type Manager** (ATM) fonts, providing an improved level of function
- TrueType** font support
- Ability to start DOS and OS/2 applications from within a Windows application
- Seamless WIN-OS/2 3.1 display drivers for VGA, SVGA, and XGA*
- Support for Windows 3.1 printer drivers
- Redesigned DDE and Clipboard support, with increased performance
- Improved WIN-OS/2 setup and configuration
- Inclusion of the File Manager and other Windows 3.1 applets

If OS/2 2.0 is upgraded to OS/2 2.1, WIN-OS/2 3.0 will be automatically replaced by WIN-OS/2 3.1. If WIN-OS/2 3.1 is not selected for installation, then WIN-OS/2 3.0 will be removed.

WIN-OS/2 3.1 Appearance

When WIN-OS/2 is installed on an OS/2 2.1 system, a new WIN-OS/2 Groups folder can be seen on the

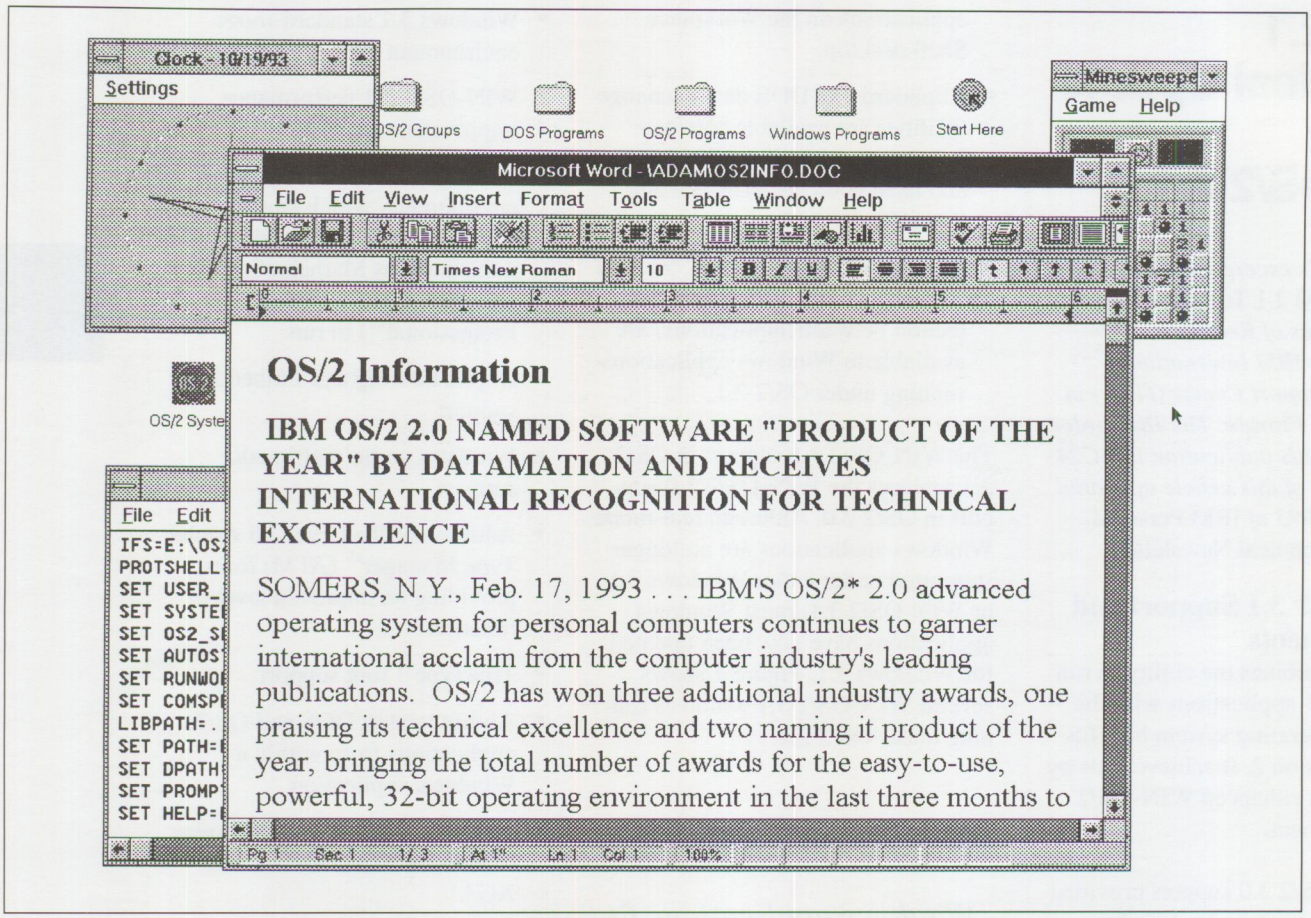


Figure 1. WIN-OS/2 3.1 Running Under OS/2 2.1 in XGA Mode

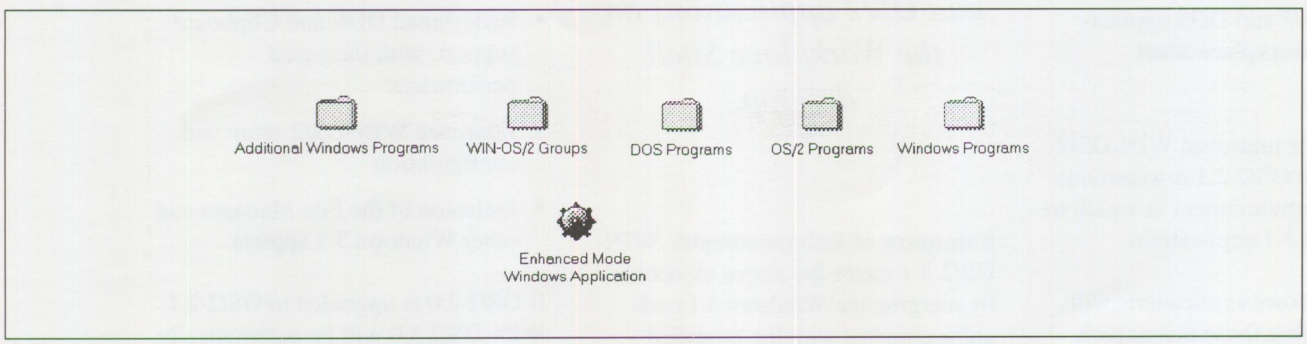


Figure 2. WIN-OS/2 3.1 Folders on the OS/2 2.1 Desktop

desktop, and the Windows Programs and Additional Windows Programs folders (if present) now use the standard folder icon. The desktop with WIN-OS/2 3.1 installed is shown in Figure 2.

The WIN-OS/2 Groups folder contains two other folders:

- WIN-OS/2 Main, which contains the Windows utility and setup programs, such as the File Manager and the Control Panel
- WIN-OS/2 Accessories, which contains the Windows applets, such as Write and PaintBrush.

The contents of these folders are shown in Figure 3.

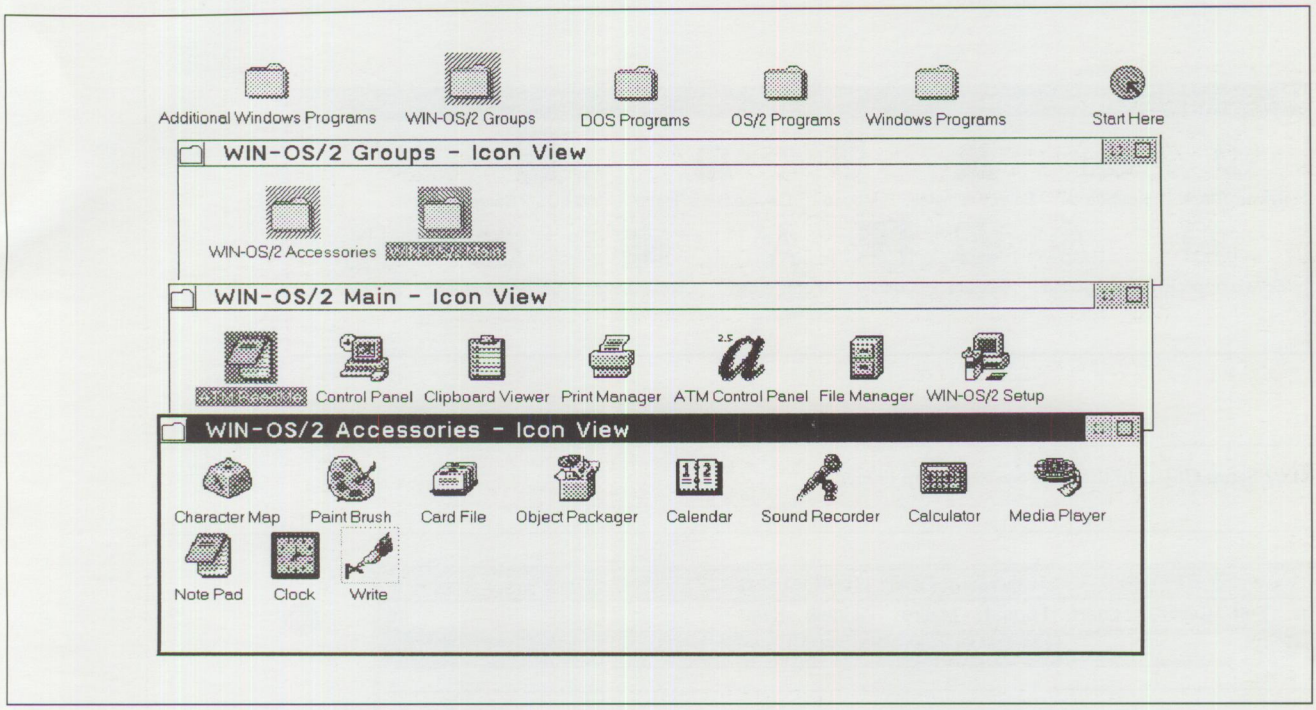


Figure 3. Contents of the WIN-OS/2 Groups Folders

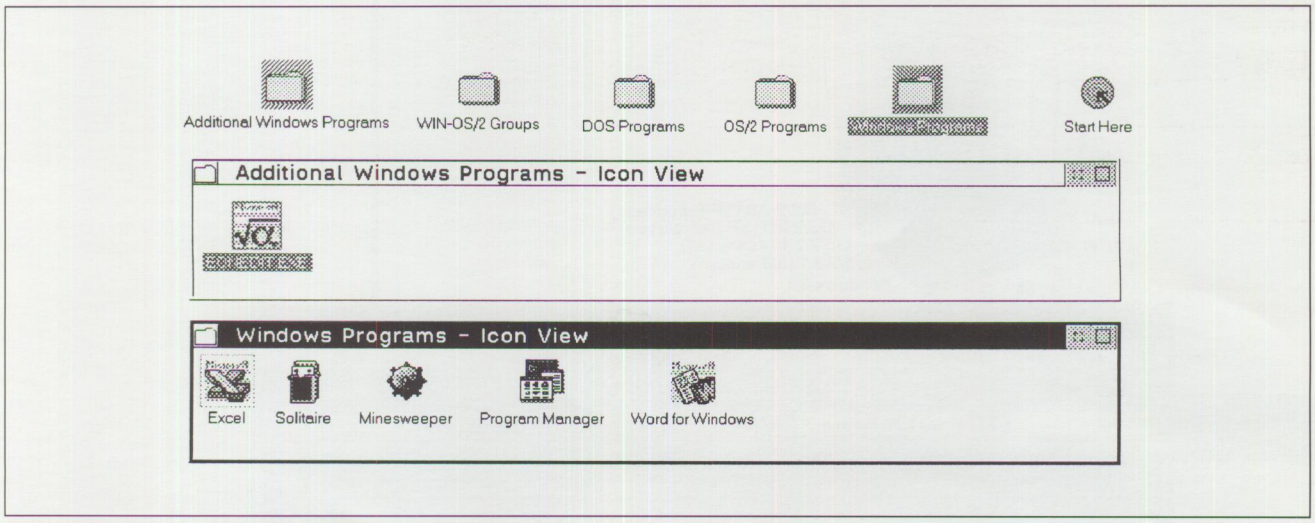


Figure 4. Contents of the Windows Programs Folders

The Windows Programs folder contains the WIN-OS/2 3.1 program manager (PROGMAN.EXE), along with any Windows applications defined in the migration database and migrated using the OS/2 2.1 Migrate Applications utility.

The Windows Additional Programs folder contains any WIN-OS/2 3.1 applications that are not defined in the migration database but have been specified using the Add Programs feature of the Migrate Applications utility, and then migrated. Figure 4 shows sample contents of these folders.

In addition, a WIN-OS/2 Setup object is installed in the System Setup folder (within the OS/2 System folder). This Setup object is used to configure application defaults for

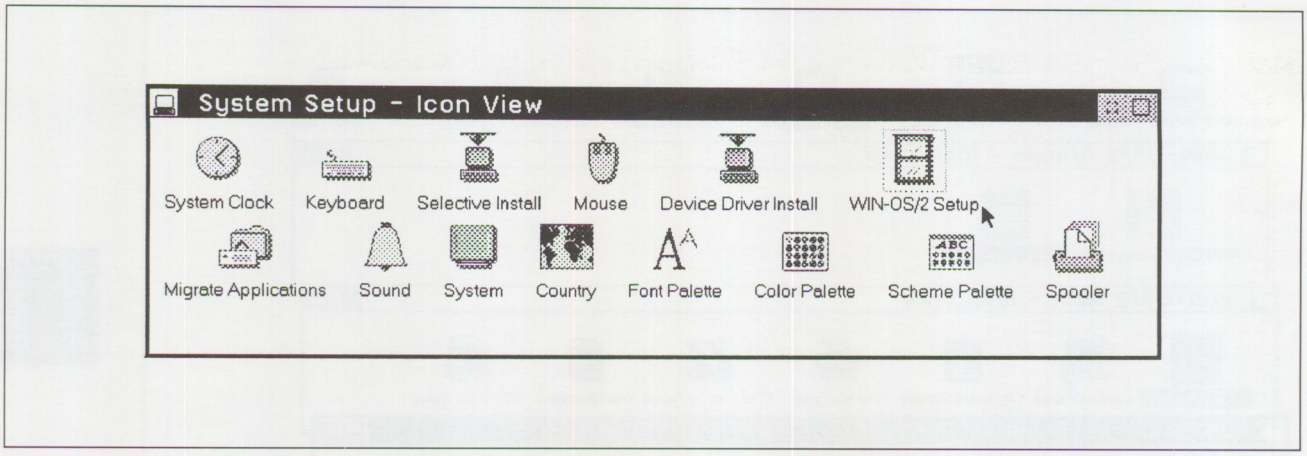


Figure 5. WIN-OS/2 Setup Object in the OS/2 System Setup Folder

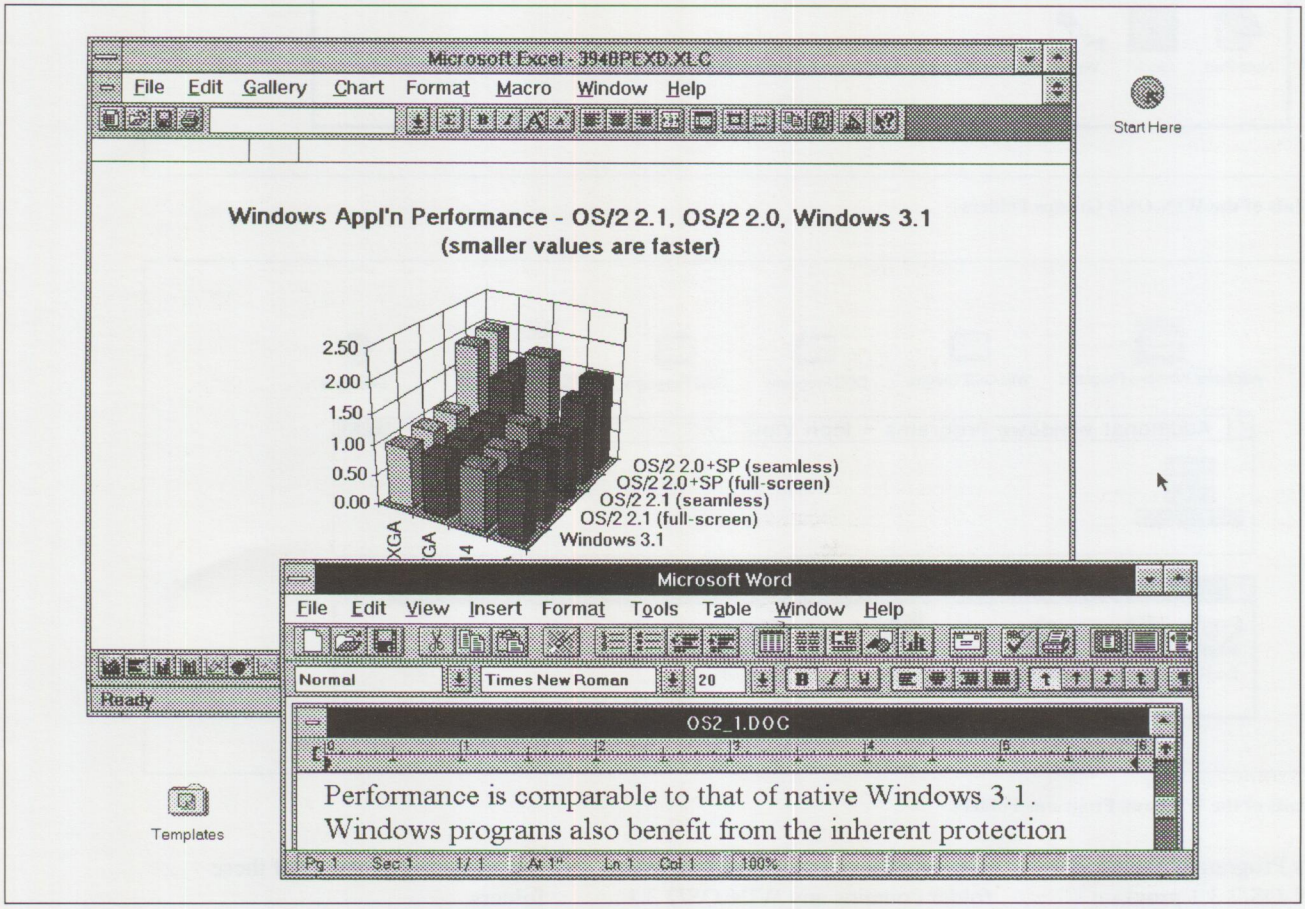


Figure 6. Windows 3.1 Applications Running in WIN-OS/2 3.1 Standard Mode

Windows applications running under WIN-OS/2 3.1, such as Clipboard and DDE usage. Figure 5 shows the WIN-OS/2 Setup object.

Try not to confuse this WIN-OS/2 Setup object with the WIN-OS/2 Setup Windows application in the WIN-OS/2 Main folder. That application is used to configure the network options and to add applications to the program groups used by the Windows program manager.

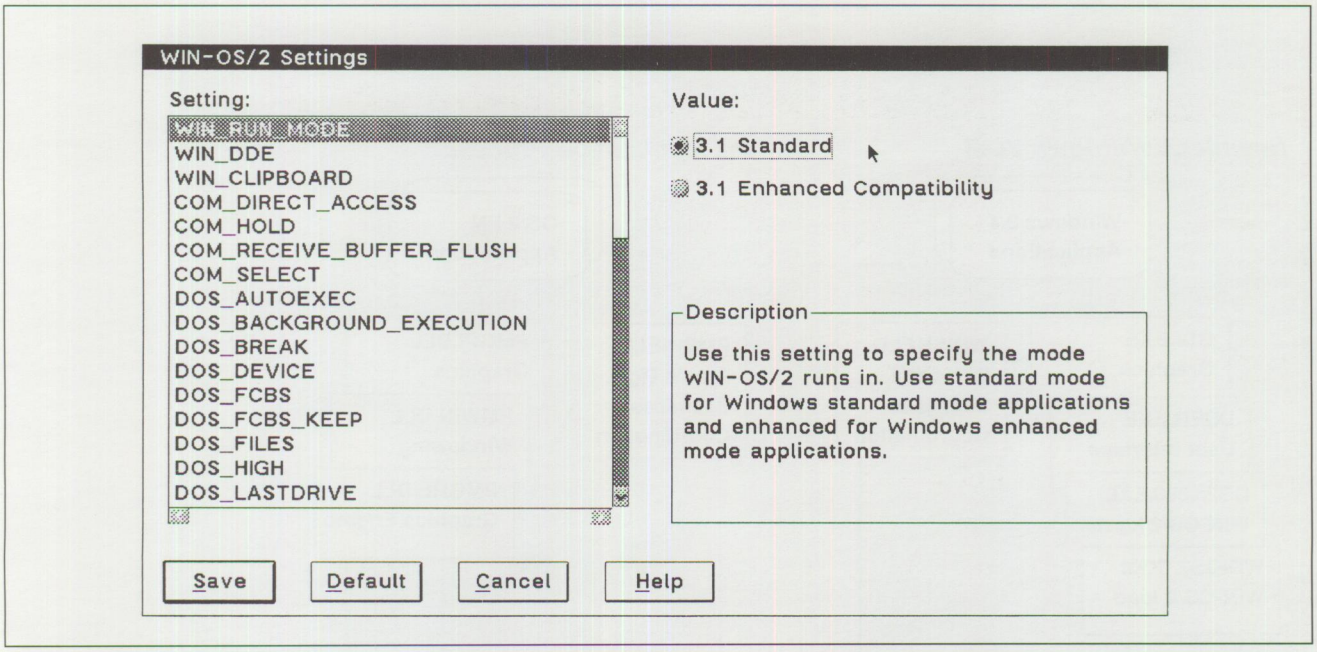


Figure 7. WIN-OS/2 Settings

WIN-OS/2 3.1 Standard Mode

A major enhancement in OS/2 2.1 is the introduction of WIN-OS/2 3.1 standard mode. This enhancement provides the equivalent of a Windows 3.1 standard-mode environment, and enables a wide variety of Windows applications to run alongside DOS and OS/2 applications, as shown, for example, in Figure 6.

WIN-OS/2 3.1 standard mode replaces the standard mode of WIN-OS/2 3.0; real mode is no longer supported.

Setting Up Applications for Standard Mode: Windows applications will default to standard mode, and no special procedure normally needs to be followed.

To check that standard mode has been selected, display the WIN_RUN_MODE settings option from within the WIN-OS/2 Settings section of the Settings notebook.

The WIN_RUN_MODE settings option has changed from WIN-OS/2 3.0, and there are now two radio buttons for selection of either WIN-OS/2 3.1 standard mode or WIN-OS/2 3.1 enhanced compatibility mode, as shown in Figure 7. The WIN_RUN_MODE settings option is normally set to standard mode, which is the recommended option unless the application requires 386 enhanced mode.

The default AUTOEXEC.BAT file is normally used for running Windows applications in a VDM. However, the DOS_AUTOEXEC setting can be used to execute a specific DOS batch command file when the Windows application is started. Use of this setting is exactly the same as for DOS applications.

Implementation: WIN-OS/2 3.1 runs a modified copy of the Windows 3.1 code in a Virtual DOS Machine (VDM). These modifications are necessary because Windows 3.1 can only act as a DOS Protected Mode Interface (DPMI) host. Thus, it cannot run in an OS/2 Version 2 VDM, where it would have to be a DPMI client underneath OS/2 (acting as the hypervisor).

Changes are also necessary to share the display with Presentation Manager*, and to integrate into the Workplace Shell desktop.

A simplified overview of the WIN-OS/2 3.1 module structure is shown in Figure 8.

In a similar structure to Windows 3.1, the GDI module handles the graphics, the USER module manages the user interface and windowing, and the OS2K386 module performs the extra kernel functions. These interact with device drivers.

There are two different WIN-OS/2 display drivers for each video configuration, one for full screen and one for seamless operation.

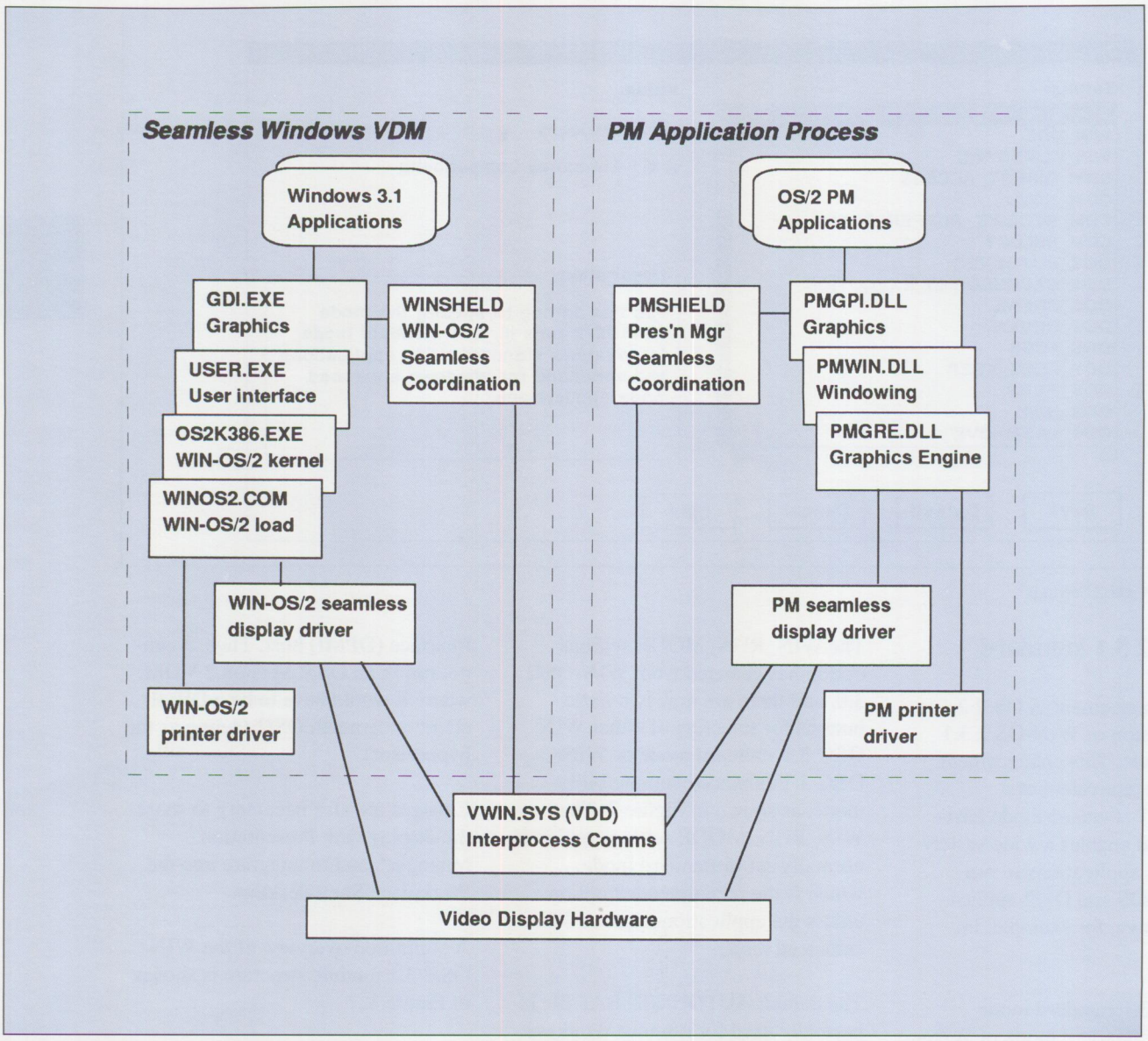


Figure 8. Overview of WIN-OS/2 3.1 Seamless Windows

Coordination between WIN-OS/2 3.1 and the rest of OS/2 is handled via the VWIN.SYS virtual device driver. In addition, the seamless mode of operation is coordinated by the WINSHIELD module in WIN-OS/2 and the PMSHIELD module in Presentation Manager. In effect, WIN-OS/2 and PM each own part of the display, and write directly to the hardware. The job of WINSHIELD, PMSHIELD, and VWIN is to coordinate these actions, and to ensure that each component writes only to the part of the display that it owns.

Coordination between WIN-OS/2 3.1 and the rest of OS/2 is handled via the VWIN.SYS virtual device driver.

WIN-OS/2 Enhanced Compatibility Mode

Windows 3.1 enhanced-mode applications that do not access VxDs (a specific type of Windows device driver) can run under WIN-OS/2 3.1 in enhanced compatibility mode. This includes applications such as

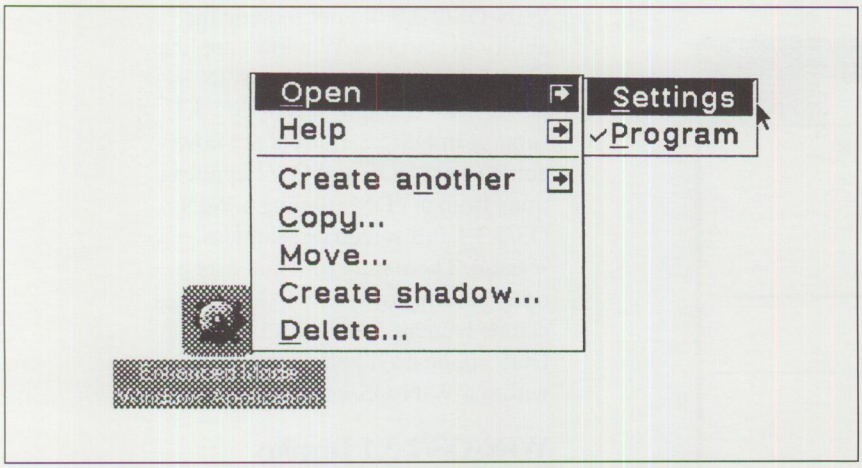


Figure 9. Enhanced Compatibility Mode: Accessing the Settings Notebook

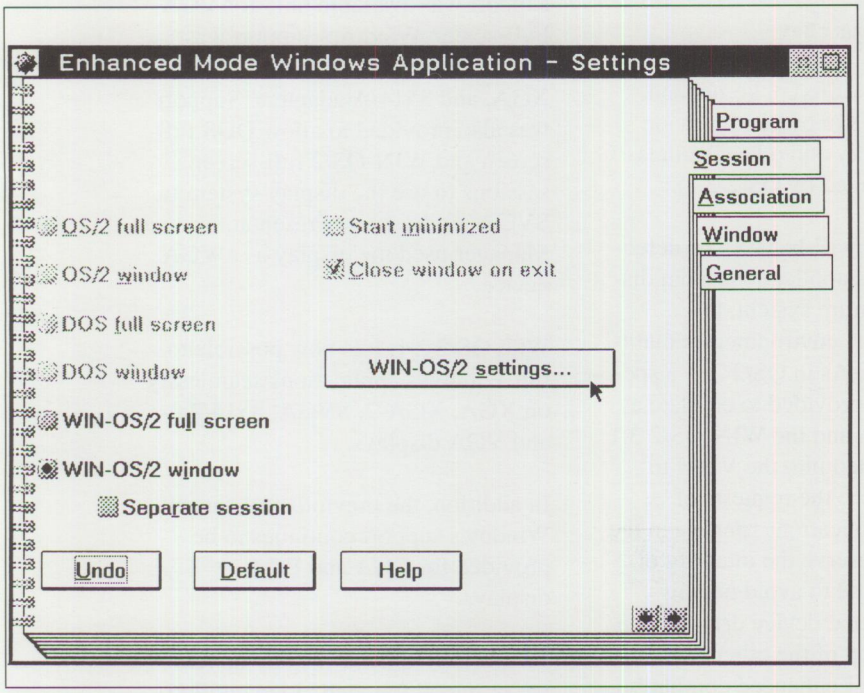


Figure 10. Enhanced Compatibility Mode: Accessing the WIN-OS/2 Settings

Mathematica for Windows and Omnipage Professional.

This is not an implementation of Windows 3.1 386 enhanced mode, but a mode specific to WIN-OS/2 3.1 that enables major Windows enhanced-mode applications to run. OS/2 Version 2 users already enjoy many of the benefits of Windows 3.1 enhanced mode, such as virtual memory, through the built-in functions of OS/2 Version 2.

Setting Up Applications for Enhanced Compatibility Mode: Enhanced-mode Windows applications registered in the OS/2 Migration Database will be set up for WIN-OS/2 3.1 enhanced compatibility mode if the Migrate Applications utility is used.

To verify this, or to manually set up an application to run in the WIN-OS/2 3.1 enhanced compatibility mode, follow these steps:

1. Display the pop-up menu of the application object by clicking the right mouse button on the application icon.

2. Display the Open options by clicking the left mouse button on the right-pointing arrow within the Open Box, as shown in Figure 9.

3. Click the left mouse button on the Settings option, and the Settings notebook for the application object will be displayed.

4. Click the left mouse button on the Session tab to jump to that page, as shown in Figure 10.

5. With either the radio button of the WIN-OS/2 full screen or the WIN-OS/2 window turned on, click the left mouse button on the WIN-OS/2 settings box, and the WIN-OS/2 Settings panel will be displayed, as shown in Figure 7.

6. With the WIN_RUN_MODE list item highlighted, click the left mouse button on the 3.1 Enhanced Compatibility Mode radio button to select the desired enhanced compatibility mode.

7. Click the left mouse button on the Save box to register the settings mode, and close the Settings notebook by double-clicking the left mouse button on the title bar icon.

Enhanced Compatibility Mode from the Command Line: To start an enhanced compatibility-mode session from an OS/2 or DOS command line, type WINOS2 /E or WINOS2 /3.

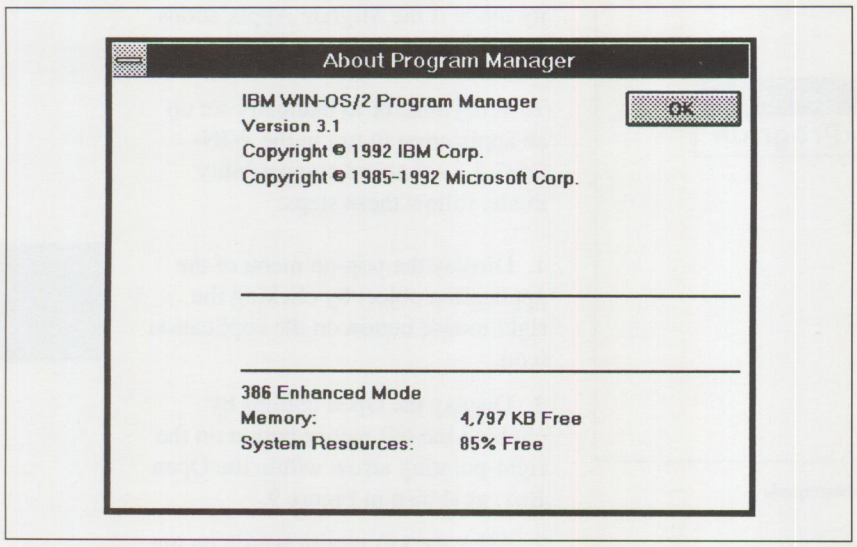


Figure 11. Enhanced Compatibility Mode: About Program Manager Box

Users may also start an application to run in the enhanced compatibility mode from the OS/2 or DOS command line by typing the application program name after the WINOS2 /E or WINOS2 /3 command. These commands are not case-sensitive, as shown in this example:

```
[C:\]WINOS2  /E hello.exe

c:\> WINOS2  /E hello.exe
```

One way to check if the run mode is enhanced compatibility mode in a multiple-applications VDM is to bring up the Help pop-up menu from the Program Manager and select About... This displays the About Program Manager box, as shown in Figure 11, which will inform the user if the session is in standard mode or enhanced-compatibility mode.

In Figure 11, note that, although it says 386 Enhanced Mode, it really means 386 Enhanced Compatibility Mode.

Implementation: WIN-OS/2 3.1 enhanced compatibility mode uses the same modules as WIN-OS/2 3.1 standard mode (unlike Windows 3.1, which uses a different kernel and other modules in order to provide virtual memory and other features already provided by OS/2 2.1).

To prevent any ill-behaved or defective Windows applications from disrupting the entire system, the WIN-OS/2 3.1 environment remains encapsulated. As in OS/2 2.0, a special VDM is provided to emulate a DPMI server, and the WIN-OS/2 3.1 kernel is loaded into the VDM to directly service the requests of Windows applications running in the VDM. To preserve the integrity of the system, and to avoid having duplicate virtual device drivers (one running on top of the other), the WIN-OS/2 3.1 enhanced compatibility mode does not use the Windows 3.1 386 enhanced mode virtual device drivers (VxDs).

Starting DOS and OS/2 Applications from WIN-OS/2 3.1

Some Windows applications rely on being able to call DOS utility programs for basic and utility functions. WIN-OS/2 3.0 did not include the ability to start non-Windows applications from a VDM running WIN-OS/2. With the new WIN-OS/2 3.1 support in OS/2 2.1, users are now able to start DOS and OS/2 applications from a VDM running a WIN-OS/2 3.1 full screen or seamless session. There may be some exceptions in terms of which DOS utilities can be launched. Figure 12 shows a DOS application being called from within a WIN-OS/2 3.1 application.

WIN-OS/2 3.1 Display Drivers

IN OS/2 2.0, seamless WIN-OS/2 support was available only for VGA. Full-screen Windows support was provided for CGA, EGA, VGA, XGA, and 8514/A adapters. Support was also provided to allow DOS full-screen and WIN-OS/2 full-screen sessions to use the display system in SVGA mode, while Presentation Manager used the display as a VGA device.

With OS/2 2.1, it is now possible to run Windows applications seamlessly on XGA, XGA-2, SVGA, 8514/A, and VGA displays.

In addition, the previous full-screen Windows support continues to be provided for CGA and EGA displays.

Two WIN-OS/2 3.1 display drivers are provided for each video configuration, one for full-screen WIN-OS/2, and one for seamless WIN-OS/2.

The full-screen WIN-OS/2 3.1 display driver is similar to a Windows 3.1 display driver, but includes some modifications such as allowing the WIN-OS/2 session to run in the background without writing to the screen.

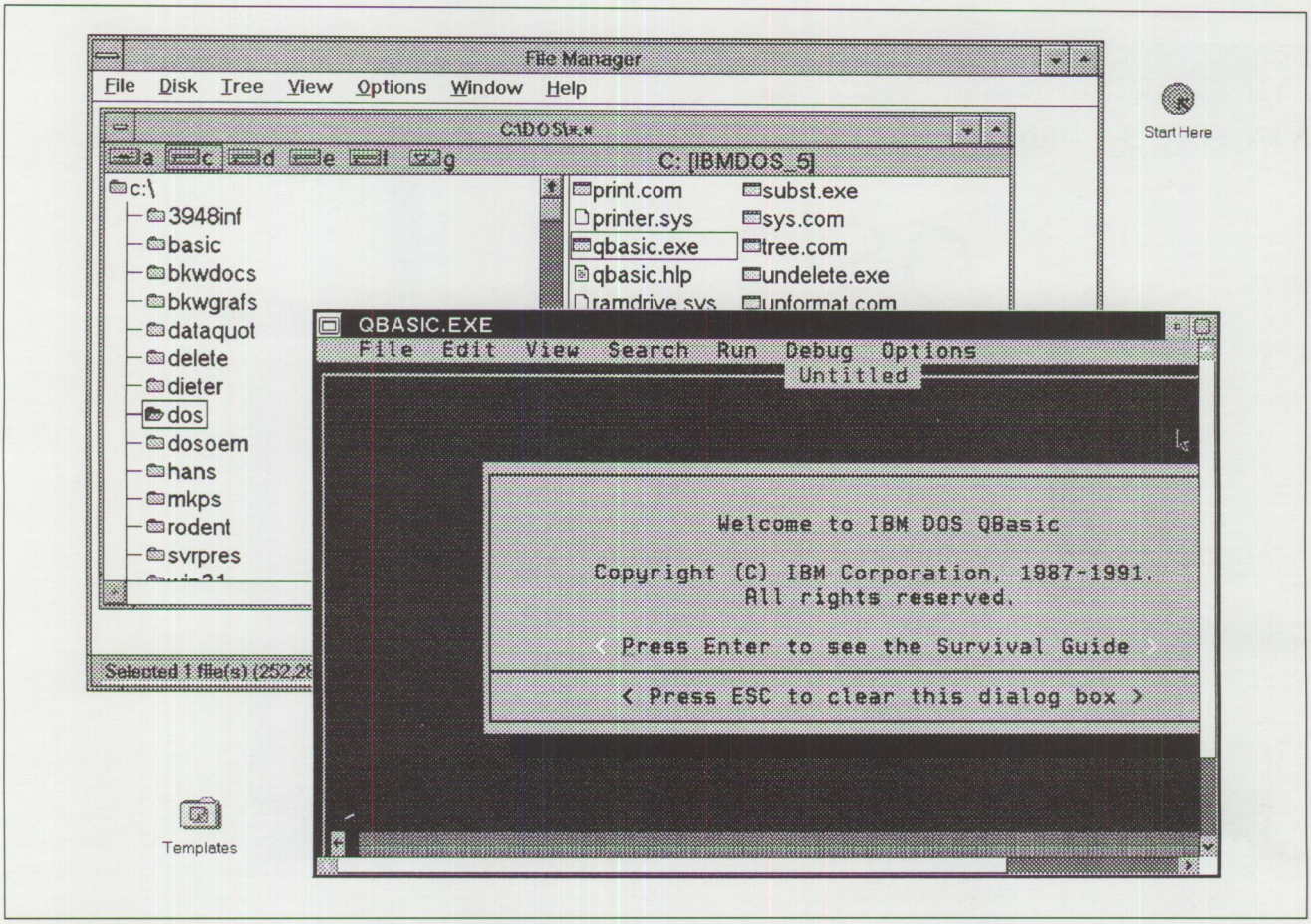


Figure 12. Calling a DOS Application From a WIN-OS/2 3.1 Application

The seamless WIN-OS/2 3.1 display drivers also need to handle running in a window. Therefore the display area is variable, and updates need to be coordinated with Presentation Manager via the WINSHIELD module.

WIN-OS/2 3.1 Printer Drivers

WIN-OS/2 3.1 improves the support for Windows printer drivers. Some new printer drivers for Windows 3.1 have been modified to work under WIN-OS/2 3.1. As a result, many additional Windows printer drivers have been packaged with OS/2 2.1.

Improved OLE Support

Object Linking and Embedding (OLE) enables compound documents to be created, modified, and printed. Compound documents are documents created using more than one application — for example, a letter with embedded graphics.

OLE enables compound documents to be created, modified, and printed.

OLE defines two approaches to compound documents:

- Embedding. The compound document contains sections "embedded" in the main document, which have been created by another application. For example, a letter created by a word-processing application could contain a diagram created by a drawing application. There is only one document, but by double-clicking on the embedded section, the second application is invoked to process the section.
- Linking. The compound document consists of one document with links to part or all of other documents that have been created by another application. The linked documents can be processed separately, or as part of the compound

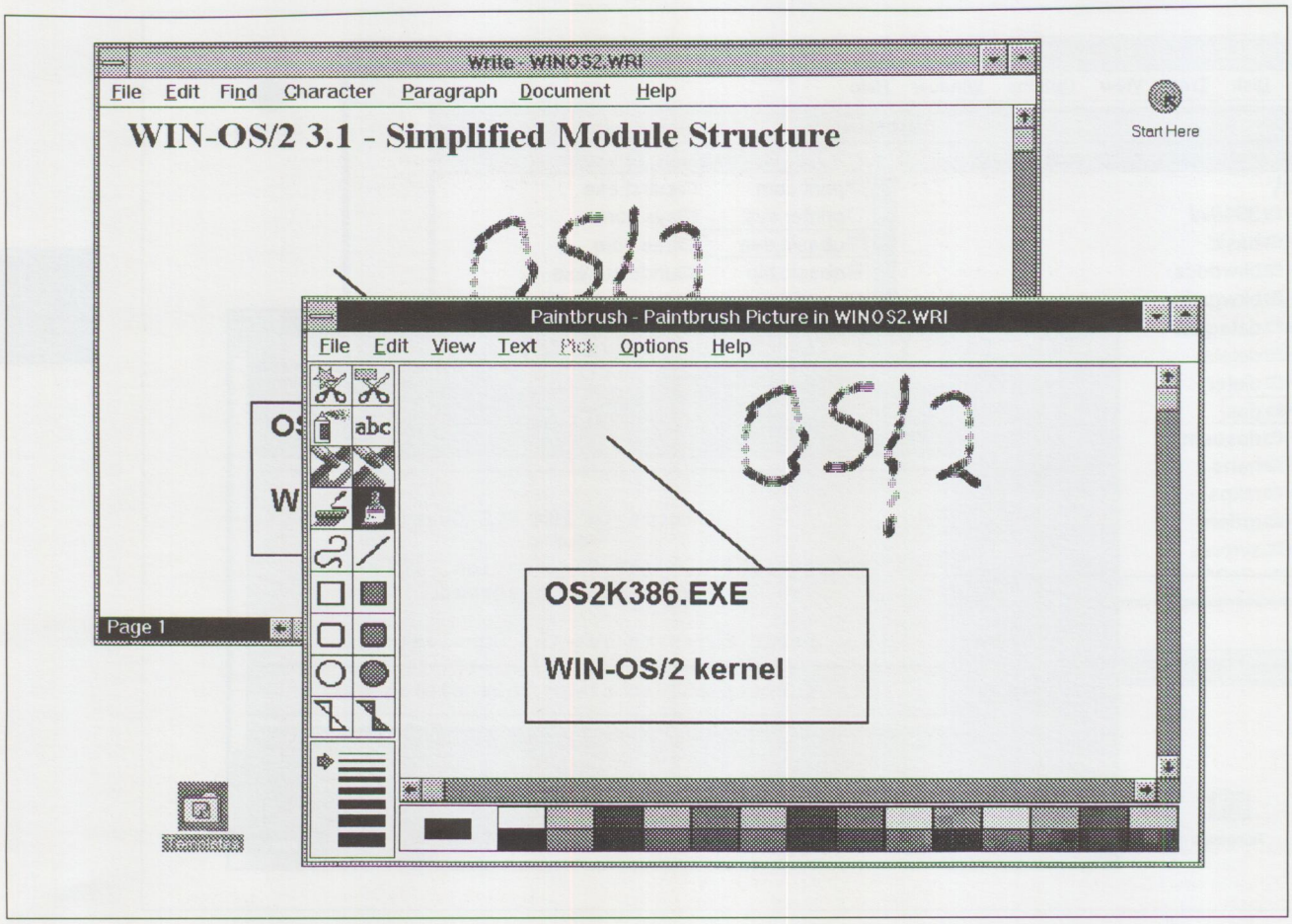


Figure 13. Windows Applications Using OLE Under WIN-OS/2 3.1

document. Changes to the linked documents are reflected in the compound document when it is processed.

Figure 13 shows two Windows applications using OLE under WIN-OS/2 3.1.

OLE implementation needs both system support and application support (from at least two applications, for obvious reasons).

In OS/2 2.1, OLE system support is supported in WIN-OS/2 3.1 within the same Windows session, either a Multiple Application Virtual DOS Machine (MAVDM) or a common seamless session. Application support is provided in a number of common Windows applications, including the Windows applets Write and PaintBrush, which are provided as part of WIN-OS/2 3.1.

DDE and Clipboard Enhancements

The Clipboard is a temporary storage area for user-initiated data transfers between applications. Dynamic Data Exchange (DDE) is a protocol and a set of functions that enable applications to exchange data through program-to-program communication. These facilities have become increasingly important since the release of OS/2 2.0, both in mixed environments of Windows and OS/2 PM applications, as well as between Windows applications and between OS/2 PM applications.

A new Workplace Shell object for the global WIN-OS/2 Settings has been added to the system. It is represented by a new icon, WIN-OS/2 Setup, in the System Setup folder, which is kept in the OS/2 System folder on the desktop. A separate object has been created, rather than using the System object, since these settings are specific to the WIN-OS/2 environment, and also to avoid crowding too many settings into the System object.

The Clipboard Viewers provided in both the WIN-OS/2 and PM are still available for users to view Clipboard

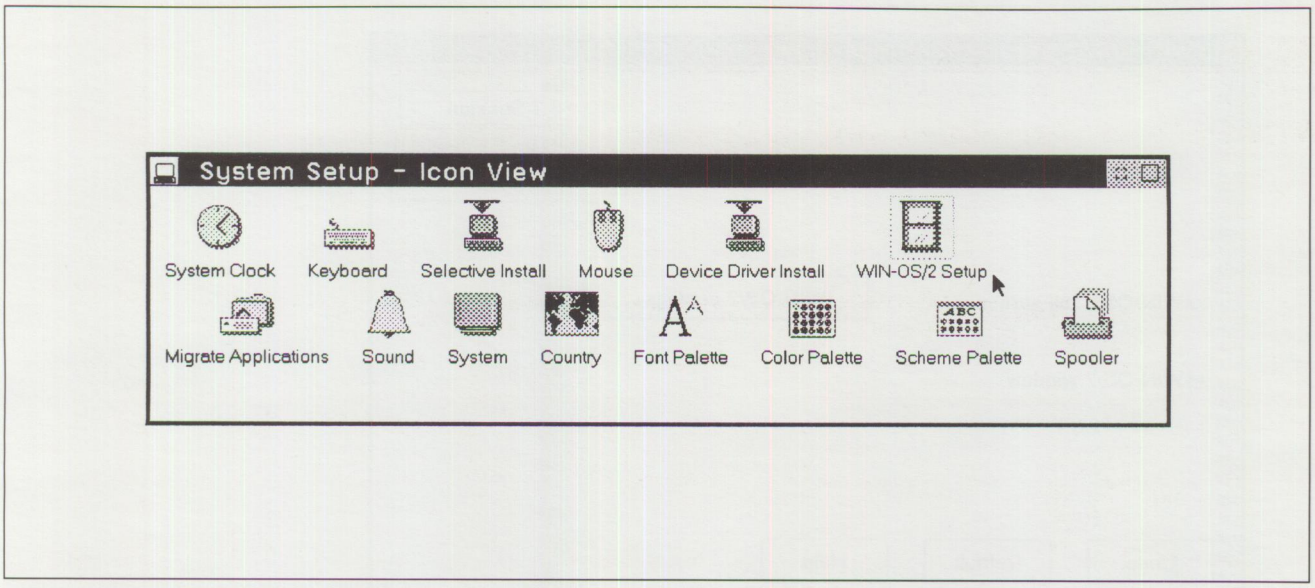


Figure 14. WIN-OS/2 3.1 Setup Object

data, but it is no longer necessary to run the Clipboard Viewers to exchange data between PM and WIN-OS/2 applications.

Setting Clipboard and DDE to Public or Private: New user interfaces have been designed to enable users to specify either public mode or private mode for the WIN-OS/2 3.1 Clipboard and DDE. By default, both the Clipboard and DDE, for both OS/2 and WIN-OS/2, are public, and users can exchange data between programs running in DOS, OS/2, and WIN-OS/2 sessions. If the WIN-OS/2 Clipboard or DDE is set to private, data exchange is allowed only among programs in the same WIN-OS/2 session.

Configuring the Clipboard and DDE as public or private is independent of whether sessions are common or separate.

Users can select the WIN-OS/2 operating mode of Clipboard and DDE for all WIN-OS/2 sessions through a new, global WIN-OS/2 Setup object in the System Setup folder of the Workplace Shell, or for a particular WIN-OS/2 separate session using the new settings in the WIN-OS/2 settings notebook page.

To make the Clipboard and DDE public or private for all WIN-OS/2 sessions, follow these steps:

1. On the OS/2 PM Desktop, double-click the left mouse button on the OS/2 System icon, and a System Setup folder icon appears.

2. Double-click the left mouse button on the System Setup folder icon, and a new WIN-OS/2 Setup icon appears, as shown in Figure 14.

3. Double-click the left mouse button on this WIN-OS/2 Setup icon to run the program, and the Settings notebook for WIN-OS/2 Setup is displayed, as shown in Figure 15.

4. The user can now set the data exchange mode (Public or Private) between PM and WIN-OS/2 applications by clicking on the respective radio buttons, as shown in Figure 16.

Note: Any selection made in the Settings window will affect all subsequent OS/2 and WIN-OS/2 3.1 sessions.

5. Finally, close the WIN-OS/2 Setup Settings notebook by double-clicking the left mouse button on the title bar icon.

To make the WIN-OS/2 Clipboard and DDE public or private for a particular WIN-OS/2 separate session, follow these steps:

1. Open the WIN-OS/2 Program folder, which contains the desired object, by double-clicking the left mouse button on the folder icon.

2. Display the pop-up menu of the program object by clicking the right mouse button on the program icon.

3. Display the Open options by clicking the left mouse button on the right-pointing arrow within the Open box.

4. Click the left mouse button on the Settings option, and a Settings notebook for the program object will be displayed.

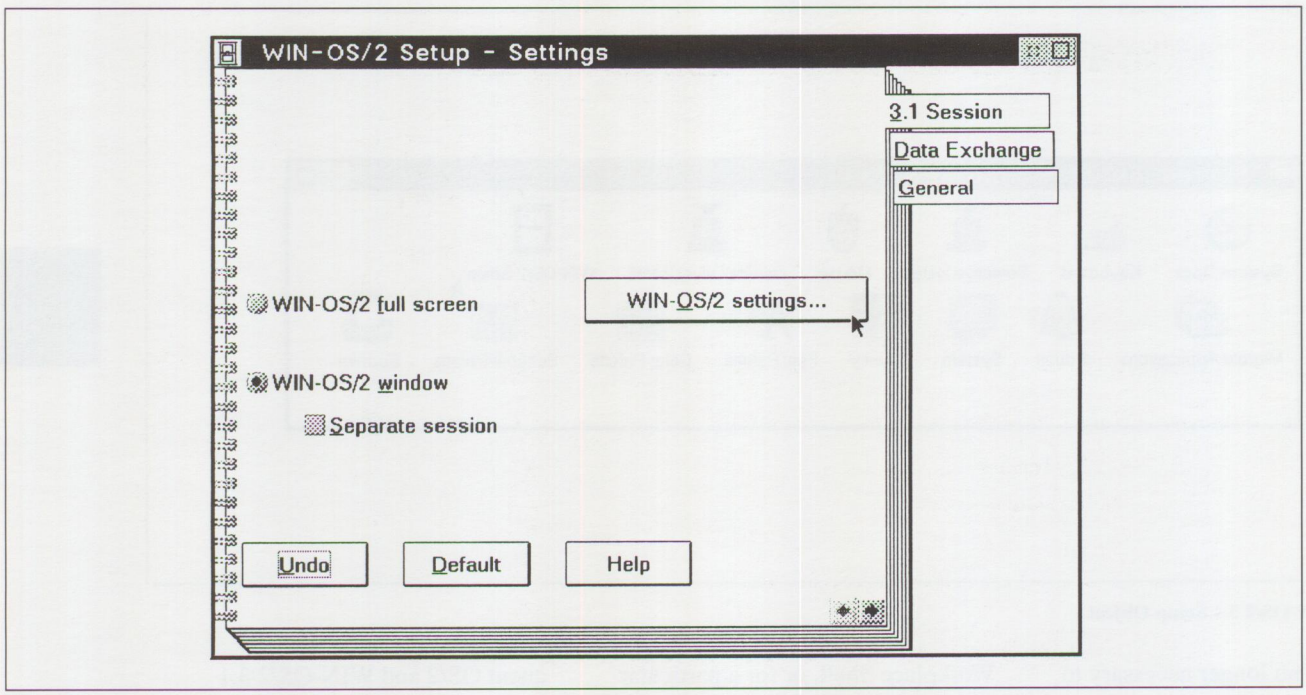


Figure 15. WIN-OS/2 3.1 Setup - 3.1 Session Definition

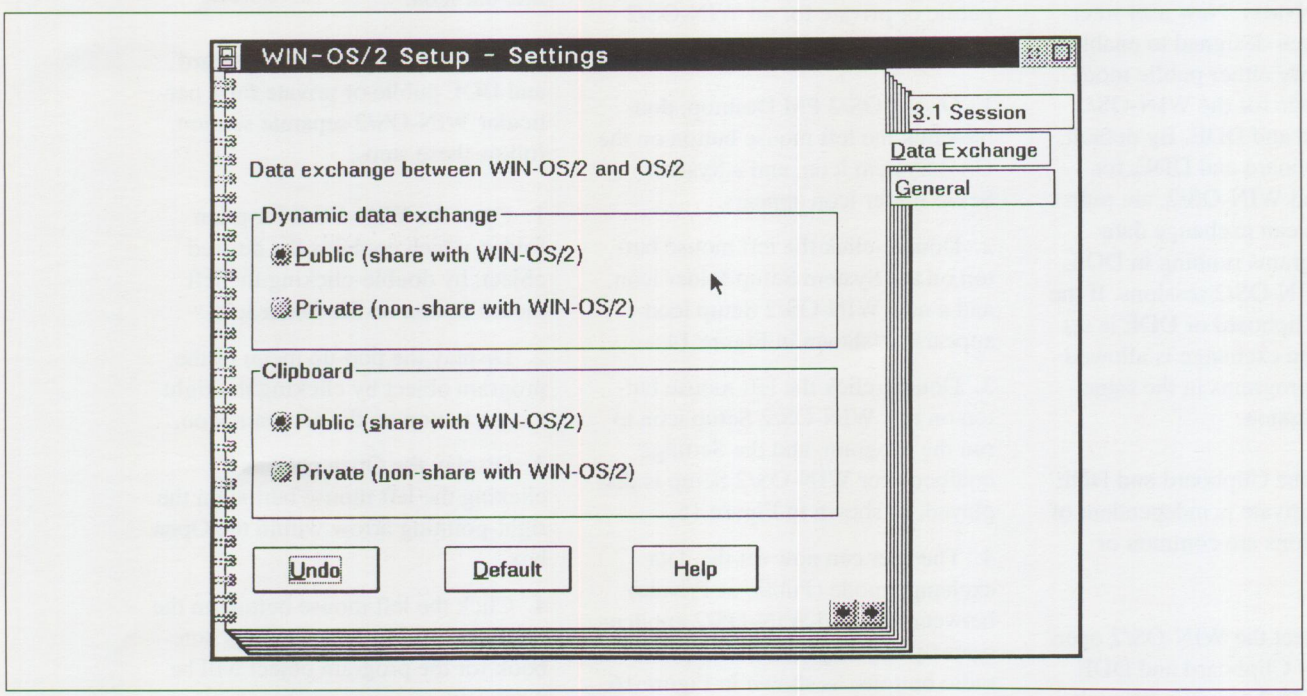


Figure 16. WIN-OS/2 3.1 Setup - Data Exchange

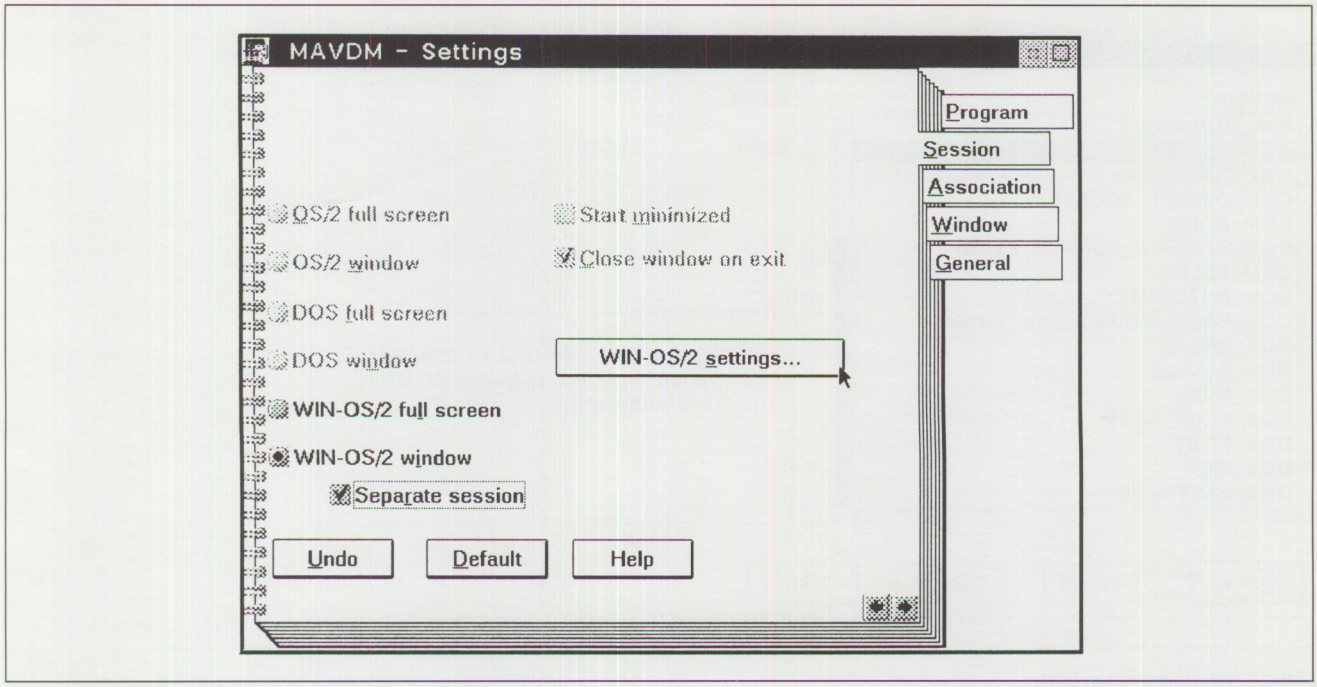


Figure 17. MAVDM Settings - Session Page

5. Click the left mouse button on the Session tab to jump to that page, as shown in Figure 17.

6. Click the left mouse button on the WIN-OS/2 Settings box to open up the WIN-OS/2 Settings panel.

7. Click the left mouse button on the WIN_DDE or WIN_CLIPBOARD item to change the operating mode of the desired facility, and the selected setting will be highlighted. The respective value and a brief description of the setting will be displayed, as shown in Figures 18 and 19.

8. Click the left mouse button on the radio button of the desired setting value, and click the left mouse button on the Save box to register the value chosen.

9. Close the program object Settings notebook by double-clicking the left mouse button on the title bar icon.

10. The program may now be restarted by double-clicking the left mouse button on the object icon.

Implementation: The Clipboard and DDE implementations in WIN-OS/2 3.1 have been redesigned to run faster and to use less system resource. These improvements have been achieved by changing the communication technique between PM and VDMs from named pipes to a Virtual Device Driver (VDD) interface. Named pipes allow related or unrelated processes to communicate with each other. As the usage of Clipboard and DDE increases, the communications traffic becomes substantially higher. This high volume of traffic can affect the performance on systems which might already utilize named pipes heavily for other purposes, or when the content of the clipboard data is very large (such as bitmaps).

The PM Clipboard and DDE programs have also been modified to be threads under PMVIOP.DLL rather than separate executable processes (as they were in WIN-OS/2 3.0).

The Clipboard and DDE programs for WIN-OS/2 have been modified to be window procedures under the WIN-OS/2 Shield (WINSHELD.EXE) rather than separate executable programs. This consolidation means that the icons for these programs have vanished from the desktop.

Multimedia Support for Audio

Windows 3.1 includes audio multimedia support as part of the base product. This is also supported in WIN-OS/2 3.1 in OS/2 2.1.

As with Multimedia Presentation Manager/2 (MMPM/2), to use these multimedia features, special hardware is required — for example, a CD-ROM drive, or an audio card.

Two Windows multimedia applets are included with WIN-OS/2 3.1:

- Media Player, which provides an interface for controlling various

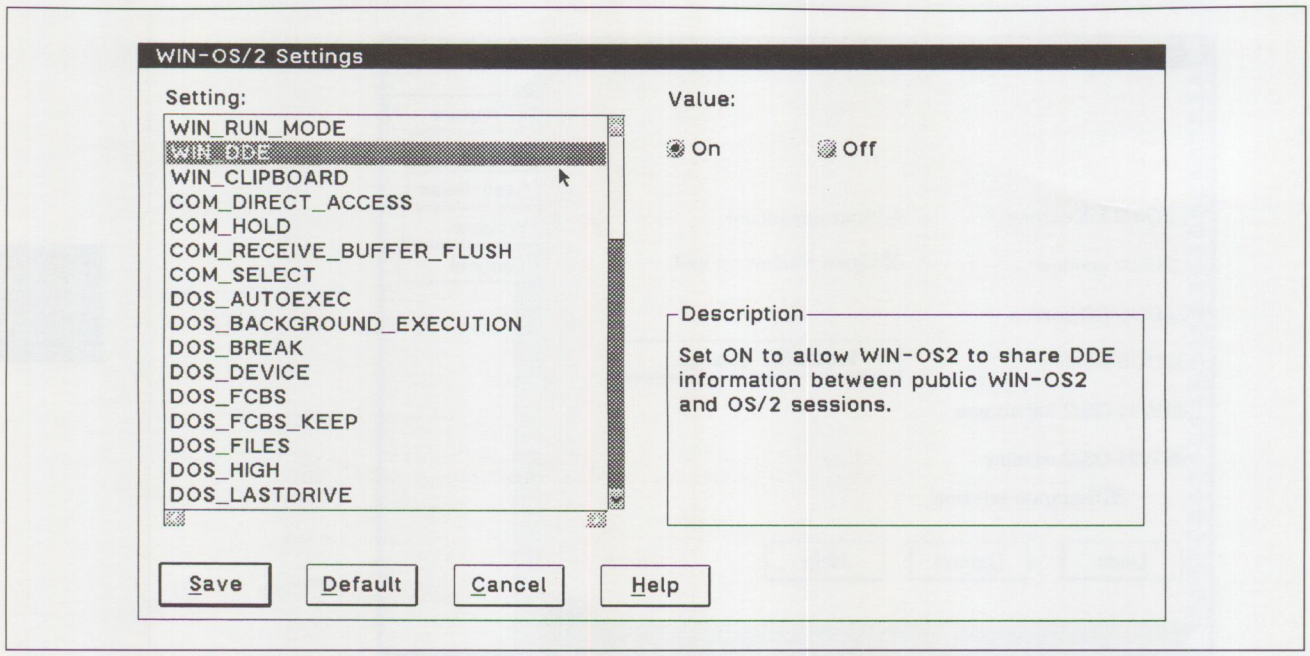


Figure 18. WIN-OS/2 3.1 Settings: WIN_DDE

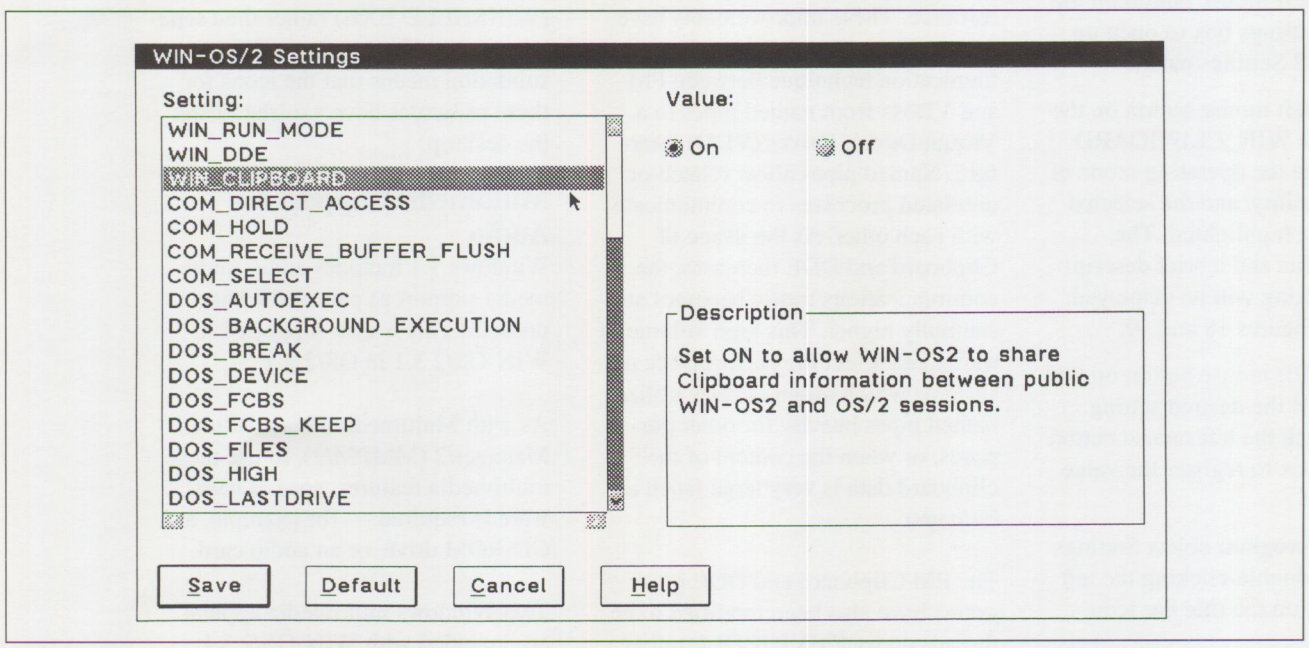


Figure 19. WIN-OS/2 3.1 Settings: WIN_CLIPBOARD

multimedia hardware, in conjunction with the appropriate device driver. For example, the Media Player can be used to play a CD through headphones attached to the phono socket.

- Sound Recorder, which works in conjunction with an audio card to enable digital sound recording and playback — for example, for voice messages.

ATM 2.5 and TrueType Font Support

Windows 3.1 includes TrueType font support. TrueType is an advanced font technology, similar in concept to Adobe Type Manager (ATM), which enables scalable fonts to be accurately displayed and printed.

WIN-OS/2 3.1 includes both TrueType and ATM font technologies. TrueType is installed by default. However, because ATM is also implemented in OS/2 2.1 PM, we suggest that ATM be used in preference to TrueType, since it simplifies moving documents and clipboard data between WIN-OS/2 and Presentation Manager.

In order to maintain compatibility for Windows 3.1 applications, TrueType font support and the base TrueType fonts are included in WIN-OS/2 3.1.

Note: The WIN-OS/2 3.1 ATM fonts are not installed by default, but can be installed from the printer driver diskettes using the ATM Control Panel from within WIN-OS/2 3.1.

Windows 3.1 Utilities and Accessories

A number of benefits are provided automatically through the inclusion of Windows 3.1 code into WIN-OS/2 3.1.

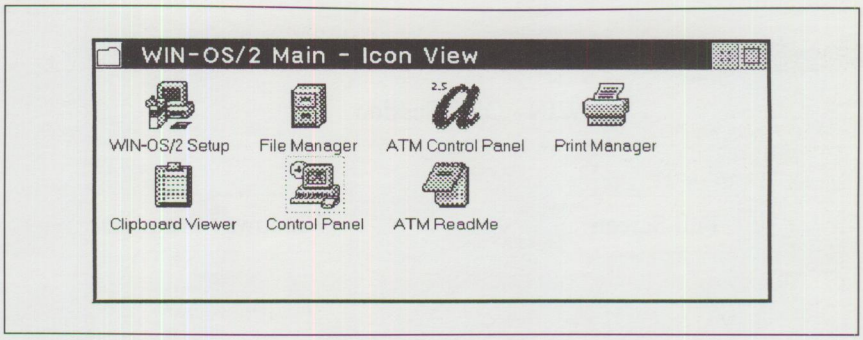


Figure 20. WIN-OS/2 3.1 - Utility Applications

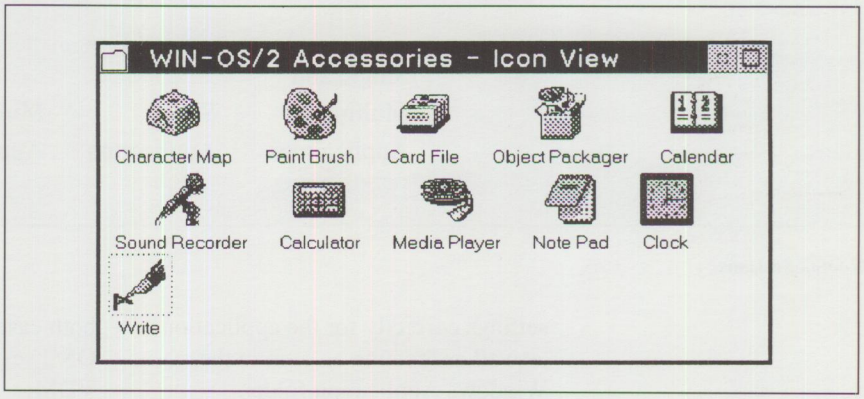


Figure 21. WIN-OS/2 3.1 - Accessories

Many of the Windows 3.1 accessories are now included with WIN-OS/2 3.1, thus enabling users to be more productive with the WIN-OS/2 environment right away. Users can also enjoy the additional benefits from the improved OLE support and multimedia support for audio.

Windows 3.0 versions of Control Panel, Print Manager, Clipboard Viewer, ATM Control Panel, and the Clock were also included with WIN-OS/2 3.0. All the other Windows applets are shipped for the first time in WIN-OS/2 3.1. The following Windows 3.1 utilities, shown in Figure 20, are now included with the WIN-OS/2 3.1 support in OS/2 2.1:

- File Manager
- Control Panel
- Print Manager
- Clipboard Viewer
- WIN-OS/2 Setup
- ATM Control Panel
- ATM Readme (a text file on a Note Pad which contains some useful information about Adobe Type Manager under WIN-OS/2 3.1)

The following Windows 3.1 applets are now included as accessories in WIN-OS/2 3.1 (see Figure 21):

- Write
- PaintBrush
- Calculator
- Clock
- Sound Recorder (use the Drivers option in the Control Panel to install sound drivers)

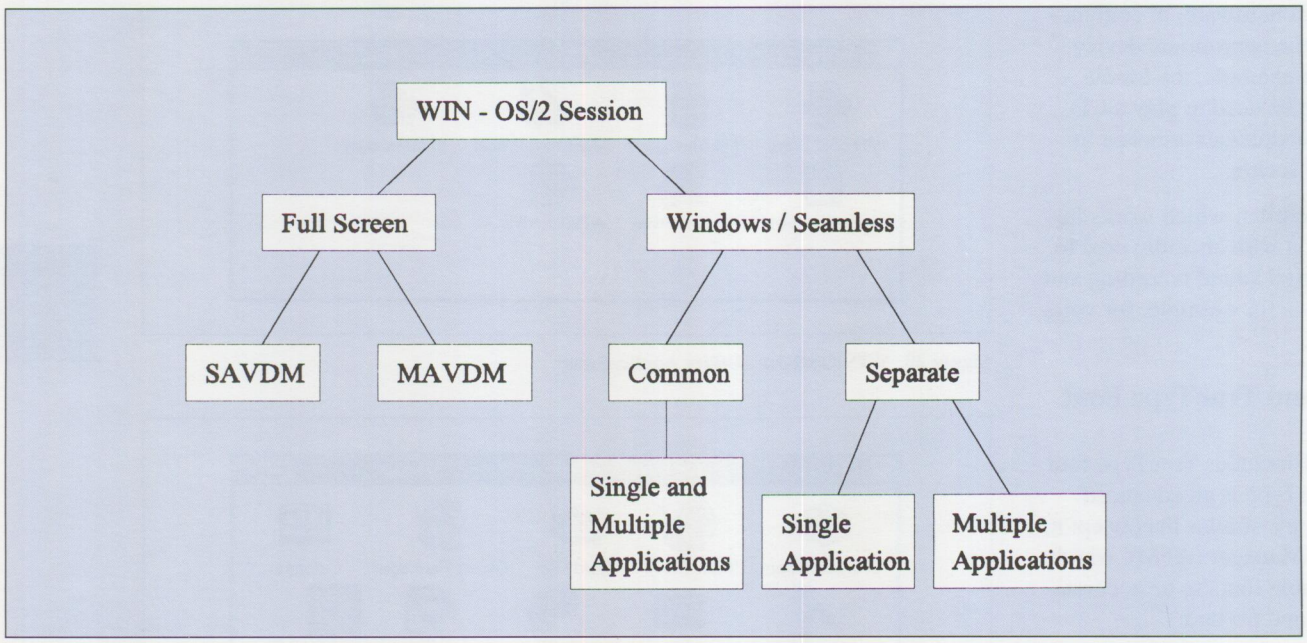


Figure 22. WIN-OS/2 Sessions

- Cardfile
- Calendar
- Object Packager
- Character Map
- Notepad
- Media Player (use the Drivers option in the Control Panel to install MCI device drivers)

A new Startup Group has been added for users to put in applications that they want to start automatically under WIN-OS/2 3.1.

The Windows 3.1 games and bitmaps, as well as the Windows Recorder and Terminal accessories, have not been included with WIN-OS/2 3.1.

The Migrate Application Utility

We recommend the use of the OS/2 2.1 Migrate Application utility once the Windows application has been installed. This sets up the WIN-OS/2 settings correctly for the application, as well as creating an icon in the Windows Application folder.

Different Ways of Running WIN-OS/2 3.1 Applications

There are many different ways that a WIN-OS/2 application can run. To clarify this, it is helpful to look at these ways from two different perspectives: (1) the session view, and (2) the settings view.

WIN-OS/2 Sessions: Figure 22 shows a simplified view of the various WIN-OS/2 sessions.

A WIN-OS/2 session can be either full-screen or seamless (windowed). For every full-screen WIN-OS/2 session, one Virtual DOS Machine (VDM) is started. If it runs just one application, it is called a Single Application VDM (SAVDM). If it runs more than one application (which it achieves by using the Windows program manager PROGMAN.EXE), it is called a Multiple Application VDM (MAVDM). In both cases, there is only one WIN-OS/2 session, running in a single VDM.

A seamless WIN-OS/2 session can be either a separate seamless VDM or a common seamless VDM. Like the full-screen WIN-OS/2 session, a separate seamless VDM can run either a single application or (using PROGMAN.EXE) multiple applications. Again, there is only one WIN-OS/2 session, running in a single VDM. But unlike the full-screen WIN-OS/2 session, a separate seamless VDM runs its applications seamlessly on the Workplace Shell desktop.

In a common seamless VDM, there can be one or more WIN-OS/2 sessions running seamlessly in a single VDM. Each WIN-OS/2 session can run one or more applications. There is only one common seamless VDM in the entire system, and all seamless WIN-OS/2 sessions that are not defined as separate will run in this common seamless VDM.

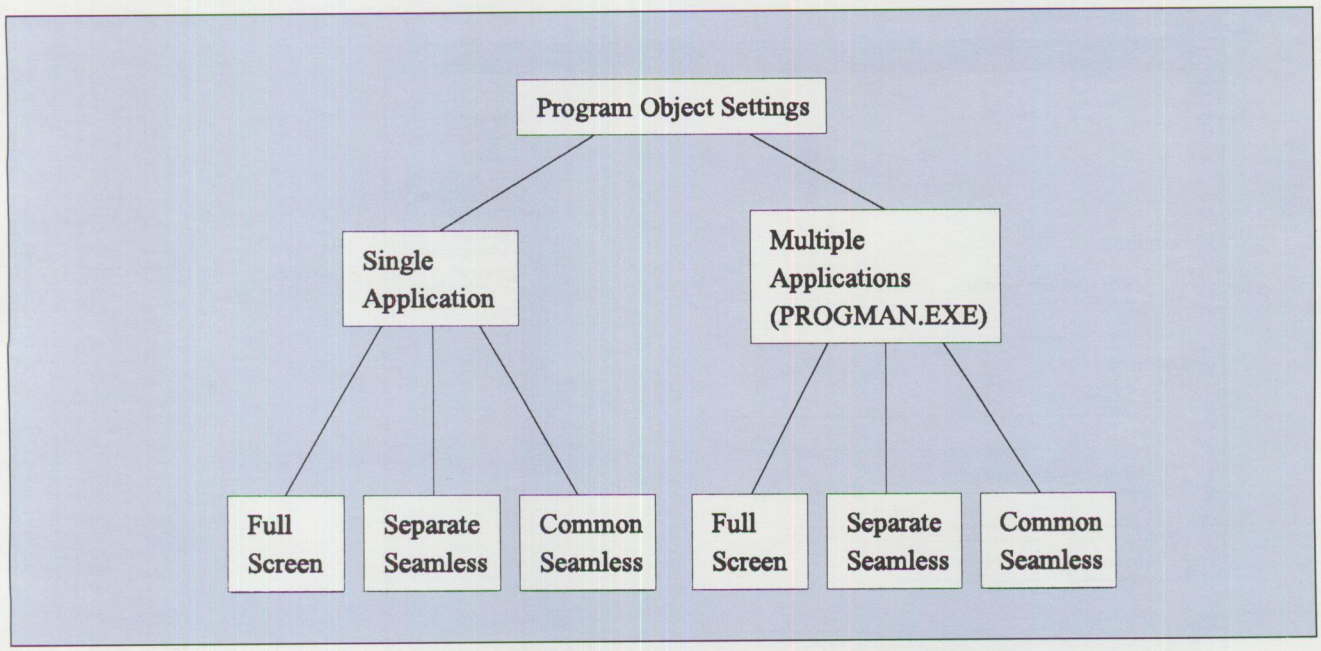


Figure 23. Different WIN-OS/2 Program Object Settings

Note: The first seamless WIN-OS/2 session launched that is not separate will set up the common seamless VDM with its own environment settings, and all subsequent common seamless VDM sessions will share this environment. Take this into consideration when deciding which common seamless VDM WIN-OS/2 session to start first, and ensure that the environment that this session sets up is appropriate for the entire VDM.

WIN-OS/2 Program Object Settings: Windows applications should normally be installed on the Workplace shell by using the Migrate Applications utility, since this will tailor the WIN-OS/2 settings based on information in the migration database.

However, it is also possible to define a new WIN-OS/2 application on the Workplace Shell by creating a new program object from the Templates folder. Users may also make a copy from any existing program object, but remember to check through the settings that were inherited, and change them appropriately. Figure 23 shows a structured summary of WIN-OS/2 program object settings.

Follow these steps to bring up the Program Object Settings notebook:

1. Display the pop-up menu of the program object by clicking the right mouse button on the program icon.
2. Display the Open options by clicking the left mouse button on the right-pointing arrow within the Open box.
3. Click the left mouse button on the Settings option, and a Settings notebook for the program object will be displayed, as shown in Figure 24.

There are two scenarios for the program object definition, one for the single-application environment, and the other for the multiple-applications environment.

For a single application definition, type in the name of the application program in the "Path and file name" field, as shown in Figure 25.

For a multiple applications definition, type PROGMAN.EXE in the "Path and file name" field, and the names of the application programs (separated by commas) in the Parameter field. An example of defining three applications is shown in Figure 26.

Once the Program definition has been done, go to the Session definition by clicking the left mouse button on the Session tab. For both the single-application and multiple-applications environments, three different types of WIN-OS/2 sessions can be set.

The first type is the WIN-OS/2 full-screen session. This is selected by clicking the left mouse button on the radio button next to the "WIN-OS/2 full screen" option, as shown in Figure 27.

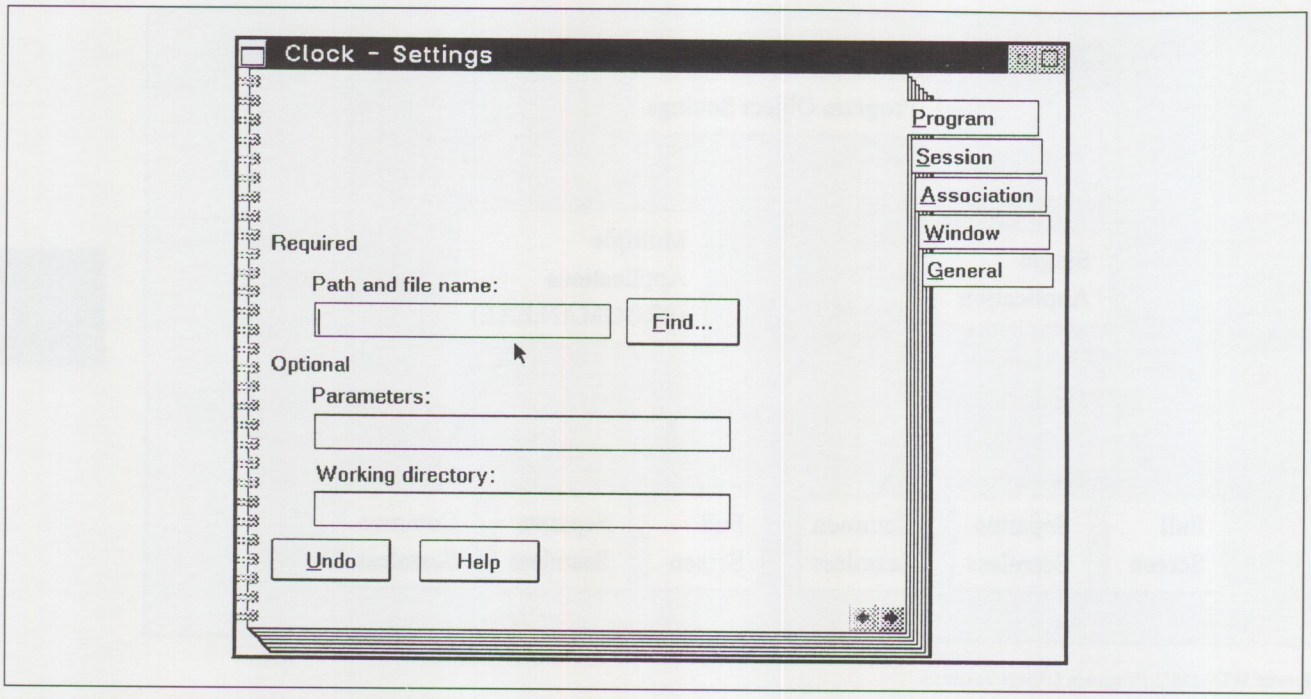


Figure 24. WIN-OS/2 3.1 - Program Object Settings Notebook

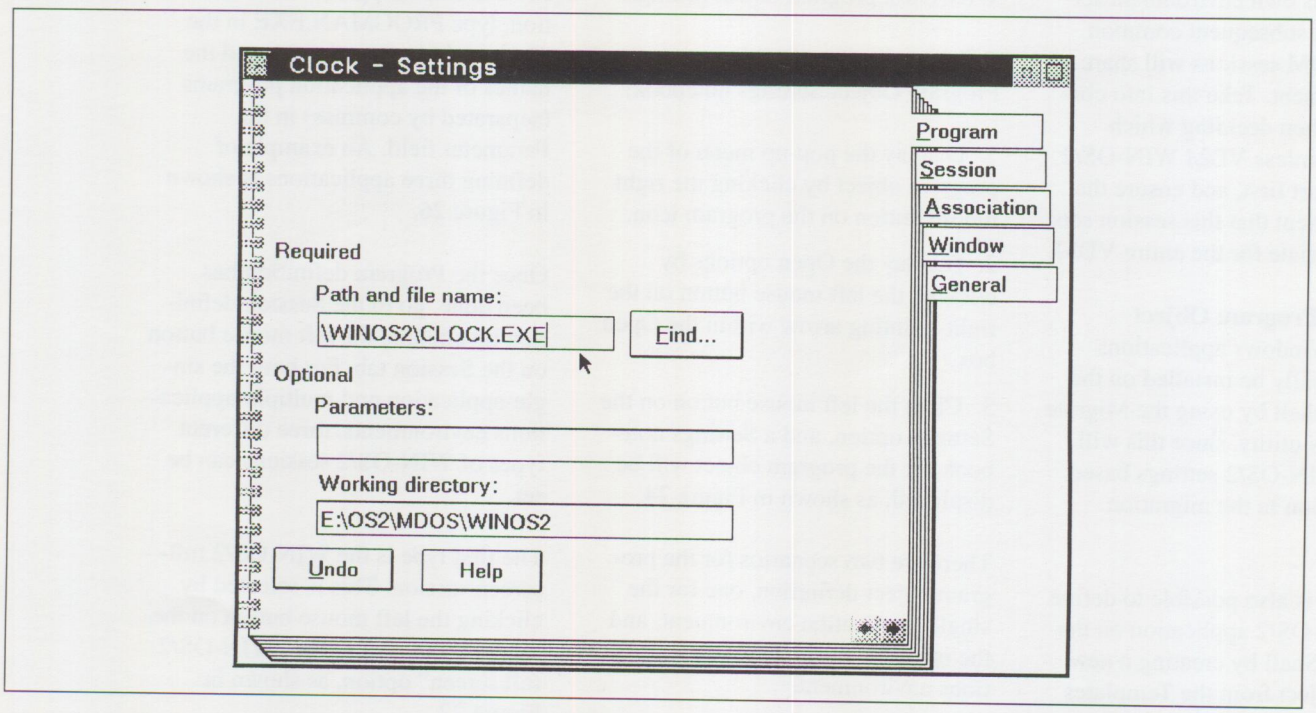


Figure 25. WIN-OS/2 3.1 - Defining a Single Application Program Object

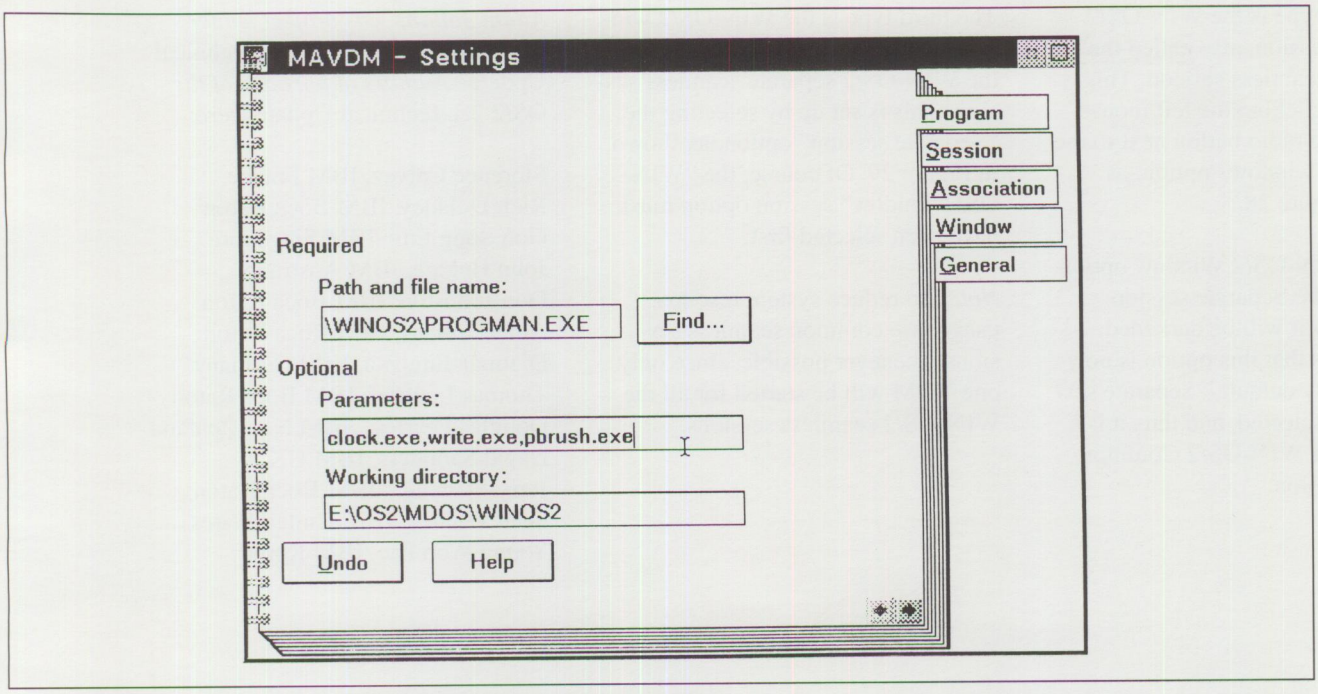


Figure 26. WIN-OS/2 3.1 - Defining a Multiple Applications Program Object

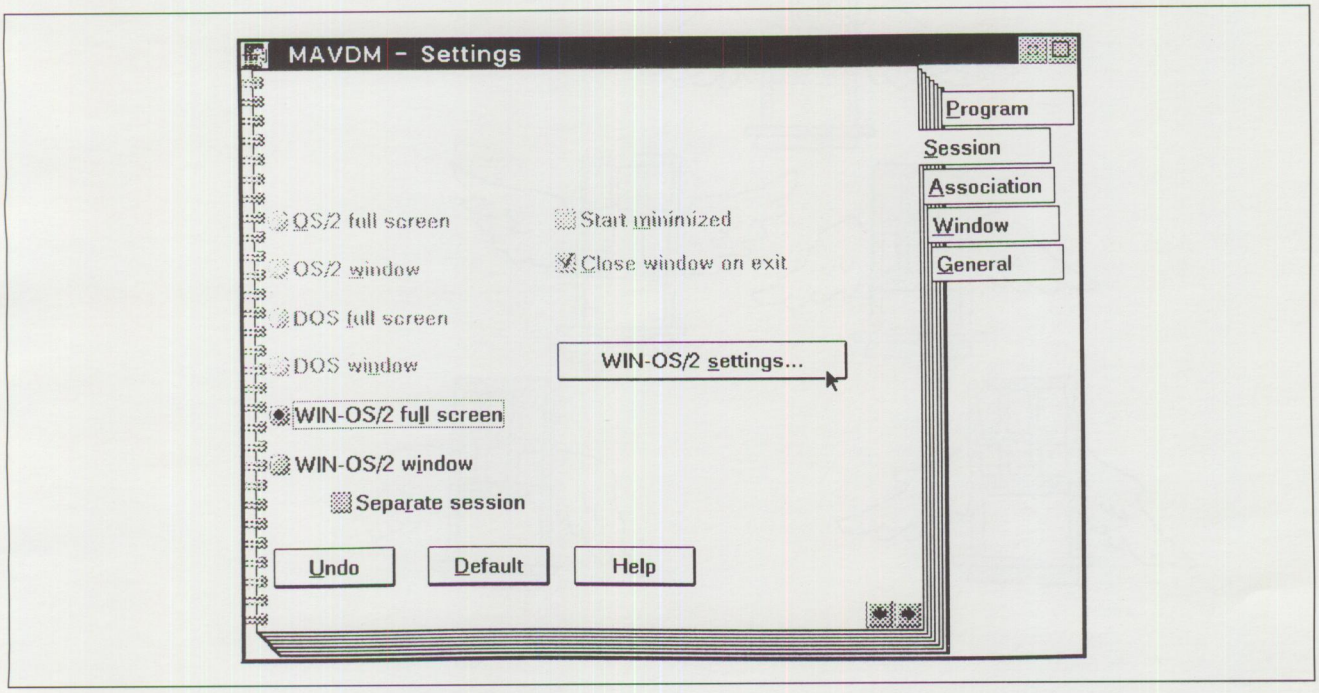


Figure 27. WIN-OS/2 3.1 - Defining a Full-Screen Session

The second type is the WIN-OS/2 windowed session, also called the WIN-OS/2 seamless session. This is selected by clicking the left mouse button on the radio button next to the "WIN-OS/2 window" option, as shown in Figure 28.

Once the WIN-OS/2 Window option is selected, the Separate session option below it will be darkened, which means that this option is now selectable. By default, "Separate session" is not selected, and thus it is a definition for WIN-OS/2 Common seamless session.

The third type is the WIN-OS/2 windowed separate session, also called the WIN-OS/2 separate seamless session. This is set up by selecting the "Separate session" option, as shown in Figure 29. Of course, the "WIN-OS/2 window" session option must have been selected first.

Note: To reduce system resource usage, use common seamless sessions whenever possible, since only one VDM will be started for all the WIN-OS/2 seamless sessions.

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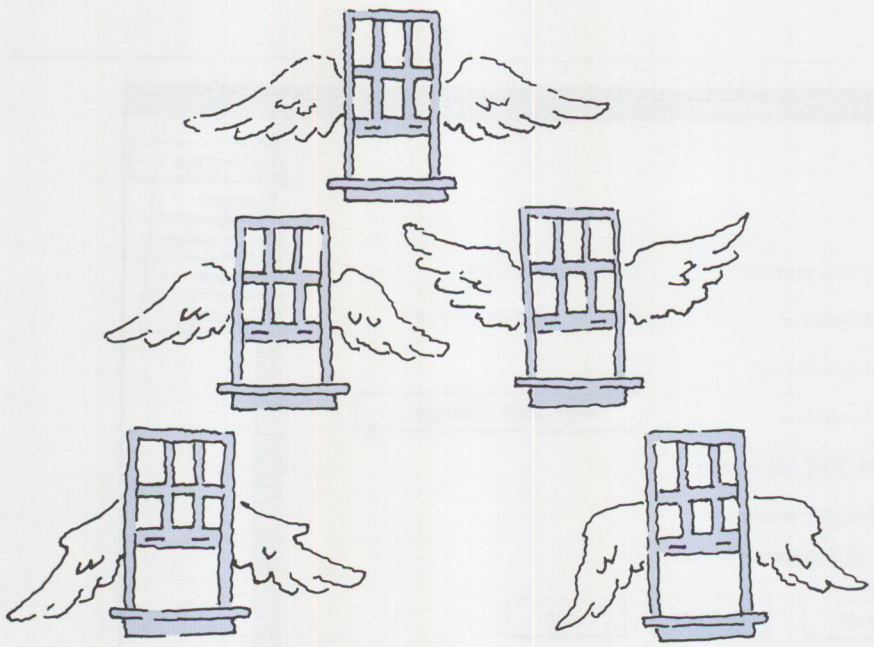
Jerry Stegenga, IBM Boca Raton
Sean Whalen, IBM United States
Young Woo Pae, IBM Korea



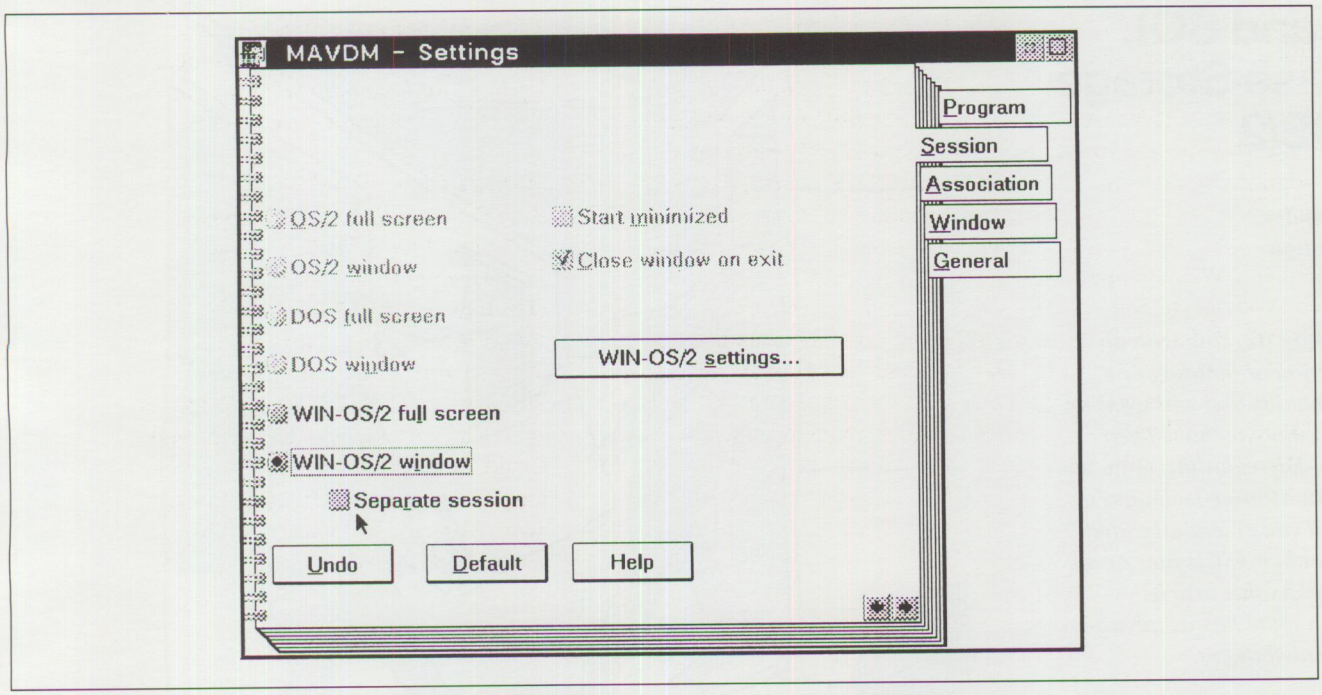


Figure 28. WIN-OS/2 3.1 - Defining a Common Seamless Session

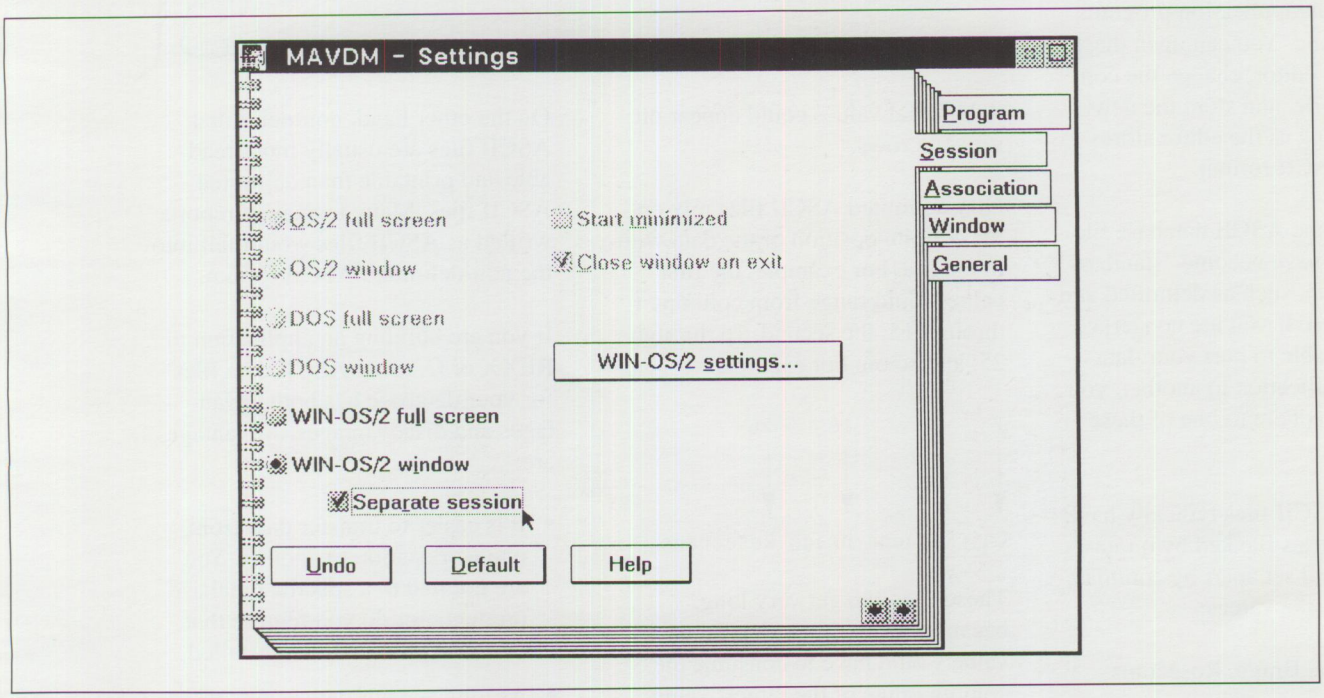


Figure 29. WIN-OS/2 3.1 - Defining a Separate Seamless Session

ASCII and SQL Database Storage with OS/2

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Whether you are working with an OS/2 application or building one yourself, eventually you will want to store the data that you have been working with. Disregarding some of the more exotic storage techniques, with OS/2 you can essentially save your data in either ASCII files or an SQL database. As this article explains, each route has its advantages and disadvantages.

ASCII Databases

There is nothing special about ASCII databases. They consist of one or more readable, plain-text files in a format that an application program can understand. You can open these files with an editor, change the contents of the file, and store the new values, as long as the editor stores the file in ASCII format.

There are some ASCII database file formats that have become "standard" in the industry, such as delimited and non-delimited. If you are concerned about being able to port your data from one application to another, you will want to adhere to one of these formats.

Delimited ASCII files typically have their data entries flanked by quotation marks and set apart by commas. For example, the values:

Chickamauga, Bragg, Rosecrans

would be represented as:

```
"Chickamauga","Bragg","Rosecrans"
```

Additional values could appear on separate rows.

Non-delimited ASCII files rely on the column position of the data within the file. For example, the first value would range from columns 1 through 15; the second, 16 through 25; and so on. For example:

```
1               16      26
↓               ↓       ↓
Chickamauga Bragg Rosecrans
```

These files can get very long, because the space needed for each value would have to consume the column range of the largest value, whether or not the other values are that long.

On the other hand, non-delimited ASCII files are usually more readable and printable than delimited ASCII files. Many formatted reports written as ASCII files would fall into the non-delimited ASCII format.

If you are building an application in REXX or C, using ASCII data files for your database has both advantages and disadvantages. Advantages are:

- It is easier to transfer data from one workstation to another. You are not tied to a specific database product, nor do you require that database product to be installed.
- As long as your data is not stored in a unique format, it is also easy to port your data from one application to another.

- For small amounts of data, your application can open and read the contents of your ASCII data files relatively quickly.
- You can easily change the ASCII files with any word processor or text editor.

Disadvantages are:

- It is difficult to store binary data. Storing a binary file will make your data file unreadable and uneditable by the OS/2 E editor or another word processor.
- Your application will have to contain logic to search, sort, save, and retrieve values within the data files. Depending on the complexity, this can result in a lot of specialized code. You may have to read in the contents of all your ASCII database files just to find a value.
- If multiple instances of your applications are run, you will have to serialize access to your ASCII files to prevent inconsistencies and inaccuracies from creeping into your data. Locking your files while they are in use, or when they have the potential to be changed, is one solution, albeit restrictive.

SQL Databases

SQL stands for Structured Query Language. It provides a standard way to define table and view objects, as well as to query the data within the objects. Data values are stored in columns, and a group of columns composes a table object. SQL databases are relational, which means you can define relationships between columns in your tables. For example, you can make one column dependent on values existing in another column. This frees your application from having to contain these rules.

The following is a sample definition of the table used in the ASCII section at the beginning of this article:

```
CREATE TABLE BATTLES
  ( LOCATION VARCHAR(15),
    USCMDR VARCHAR(10),
    CSCMDR VARCHAR(10) )
```

With SQL, you can easily construct queries that reorder data values, or retrieve values from only a certain subset of columns. Many SQL constructs are geared to creating and manipulating sets. For example, you can take the union or intersection of two value sets. Without the SQL language, you would have to write a lot of specialized code to perform these operations.

With SQL, you can easily construct queries that reorder data values, or retrieve values from only a certain subset of columns.

Advantages of SQL databases are:

- SQL provides you with a standard way to access data. The SQL language varies little from one database product to another. Only the database configuration, the steps for connecting to the database, and similar actions will change.
- Other users can run the query facilities provided with the database product to view the data in readable form. They can even write their own queries beyond those that your application provides.
- Once isolated into a module, you can port your database application relatively easily from one database to another, or from one platform to another.
- You can port your database application code relatively easily from one database to another, or from one platform to another.
- Data integrity and type checking are also built into the database product. The database will check to ensure that, for example, you do not store integer data in a character field.
- SQL databases also have built-in security features, if that is important to you. With ASCII files, anyone can read and accidentally (or purposely) delete or change your files.

A disadvantage of SQL databases is:

- Now your application requires the SQL database product to run. The user's workstation will incur the performance overhead and disk usage, whether large or slight, that the database product will bring.

Database Manager and DB2/2

IBM offers two SQL databases for OS/2: Database Manager, which is part of OS/2 Extended Services, and the follow-on product, DB2/2*.

The Database Manager product is a 16-bit application that can run on OS/2 1.3 and OS/2 2.x. Extended Services also includes Communications Manager, the forerunner to the separately available Communications Manager/2. The DB2/2 product has a 32-bit database engine.

Fortunately with both Database Manager and DB2/2, you can import delimited and non-delimited ASCII data files into tables in the SQL

```
EXEC SQL
SELECT COUNT(*)
INTO :count_tables
FROM BATTLES WHERE LOCATION='WILDERNESS';
```

Figure 1. SQL Statements

```
{
sqlastrt(sqla_program_id,0L,&sqlca);
sqlaaloc(2,1,5,0L);
sqlasetv(2,0,496,4,&count_tables,0L,0L);
sqlacall((unsigned short)24,3,0,2,0L):
sqlatop(0L);
}
```

Figure 2. Embedded SQL Statements in Figure 1 Expanded into C Code

database. Both products also provide an export function, which transfers data rows from your SQL tables to delimited ASCII files. This enables you to use ASCII database files as your primary data repository. Later, you can transfer your data to an SQL database, and run more complex queries outside of your application. The reverse transfer can be done, too.

It is easy to build an application to access an SQL database. Applications written in C, REXX, COBOL, and FORTRAN can access both Database Manager and DB2/2 databases. Source code written in all languages (except for REXX) are run through a precompiler that expands embedded SQL statements into the native source code. For example, the SQL statements in Figure 1 could expand into the C code in Figure 2 when the precompiler is run.

You can then compile the resulting code with IBM C Set ++ Version 2 or your favorite C compiler. You don't have to change the generated code. REXX support is even simpler — you don't have to run your code through a precompiler. Just load the database functions and run.

In summary, whichever route you take, it is easy to use an ASCII or SQL database with OS/2. With REXX already supplied with OS/2, you can immediately create applications that use ASCII data files. Add Database Manager or DB2/2 to your workstation, and you can readily use a robust SQL database to manage your data.

Theodore Shrader *is a senior associate programmer who joined IBM in 1989 to work on graphical interfaces to Database Manager. He has worked in graphical development since then, including work on LAN programs. He is co-author of a book titled* OS/2 2.1 Applications Programming, *which will be released in early 1994. Ted has a B.S. degree in computer science from the University of Texas at El Paso (viva Miners!).*

OS/2 2.1 Multimedia: From In-the-Box to Video In

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There are many benefits to the multimedia architecture in OS/2 2.1. This article describes those benefits and the capabilities of the multimedia audio and video applications supported by it.

Imagine a world in which personal computers greet their users with the blare of trumpets, let them look at a sound and manipulate it, play a music CD without ever turning on the stereo, and receive video help on an application without adding any extra hardware. World of the future? No — all these capabilities are provided *today* by OS/2 2.1 and its built-in multimedia support!

Previously the separate Multimedia Presentation Manager/2 (MMPM/2) product, this multimedia architecture is now included in OS/2 2.1. The multimedia architecture takes full advantage of OS/2 2.1 — it includes both audio and video applications, has an application programming interface (API) that provides hardware independence to application software, and is extensible for the future.

Provided with OS/2 2.1 Multimedia are a set of audio and video applications that serve two purposes: they provide immediate multimedia function to the user of OS/2 2.1, and they provide examples of what can be accomplished using the MMPM/2 architecture as a programming base.

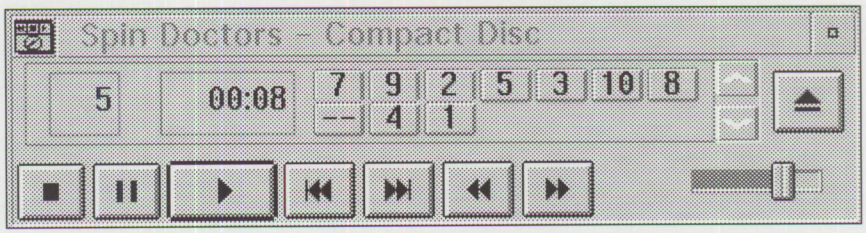

Figure 1. CD Player

MMPM/2 has already been used as the base architecture for Ultimedia Builder/2*, Ultimedia Perfect Image/2*, and Video In*. These products work together or separately to extend the multimedia capabilities of OS/2 2.1.

OS/2 2.1 Multimedia Audio

The OS/2 2.1 Multimedia base audio applications are composed of:

- CD Player
- Digital Audio Player/Recorder/Editor
- Macros for Lotus and Excel
- MIDI Player
- System Sounds

The CD Player (with the music CD of your choice) provides capabilities similar to those on a home stereo, and works with all OS/2 2.1-supported CD-ROM drives. The standard functions of playing, cueing, ejecting, skipping tracks, displaying current track, and displaying time into track, plus advanced functions — editing tracks out of a play sequence, automatic play, repeat, and shuffle — are present.

In addition to these normal functions, the software CD Player provides the ability to catalog a CD's title, and to display that title whenever the CD is loaded. There is also a software eject button; if a CD is ejected, a graphic appears, instructing the user to insert a CD.

Digital transfer of data from the CD-ROM through a sound card is possible if the card supports CD quality (16-bit stereo at 44.1 kHz), and if the CD-ROM is able to stream digital data. This enables the CD-ROM to use the Digital Signal Processor (DSP) on the card, since the DSP on the card may be better than the CD-ROM's own internal DSP. The CD audio output is then piped out the card's speaker jack, thus maintaining a higher quality of sound (Figures 1 and 2).

Digital Audio enables playing, recording, and editing of a waveform file. A *waveform* is the digital representation of audio (sound waves). A sound wave is analog and therefore continuous; to be stored digitally in a waveform file, it needs to be encoded by taking discrete samples of the wave.

Of these various encoding methods, Digital Audio plays Pulse Code Modulation (PCM), Adaptive Differential Pulse Code Modulation

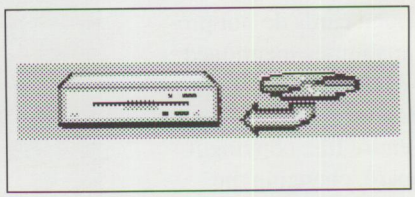

Figure 2. Insert a CD Graphic

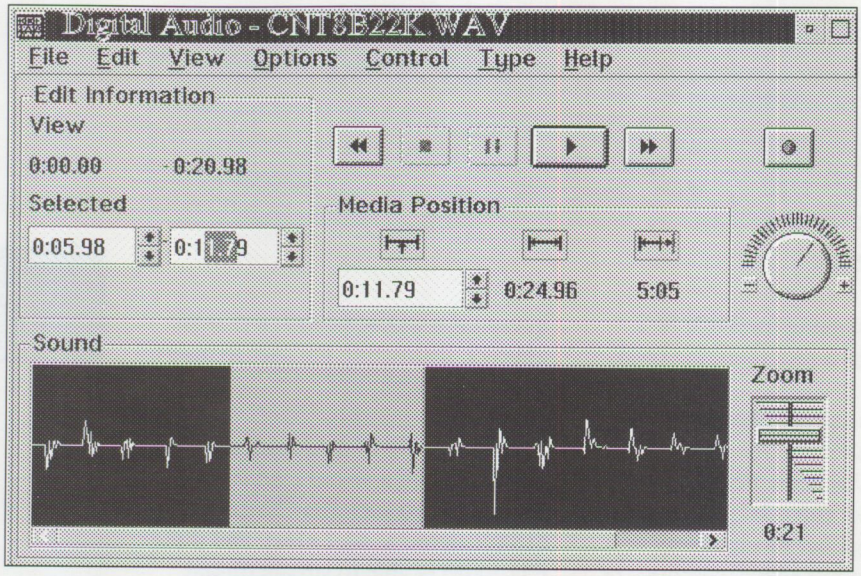

Figure 3. Digital Audio

(ADPCM), A-Law, and Mu-Law. Supported file formats include RIFF Wave and Creative Labs Voice Files (VOC). The Workplace Shell (WPS) feature of dragging and dropping a waveform file onto the application is also supported. RIFF Wave PCM files can be displayed graphically, so in addition to playing or recording into the whole file, selected ranges of the file can be played, recorded into, or edited.

Digital Audio supports recording in either stereo or mono, at a sampling rate of 11.025 kilohertz (kHz), 22.05 kHz, or 44.1 kHz (voice, music, and CD quality respectively), with a sampling precision of 8- or 16-bit. If the sound card does not support a particular capability, the option to do this in Digital Audio will not be available.

Since some sound cards do not provide all the capabilities mentioned here, Digital Audio enables audio-quality conversions for PCM files by selecting the entire file, copying it into the clipboard, changing the audio parameter settings, and pasting the original into a new file.

Because PCM files can be displayed graphically, cut, copy, and paste of an entire file, or selected regions, are done much like in an editor. In addition to these features, special effects such as mix from file or clipboard, volume change, speed change (comparable to monster and chipmunk), fade, reverb, reverse, and echo can be applied to the whole, or a part of, the file (Figure 3).

The Lotus and Excel Macros add audio enablement to a spreadsheet. These macros are available for 16-bit versions of both Lotus 1-2-3 and Excel, as well as for the 32-bit version of Lotus 1-2-3. With this audio capability, numeric information can be clarified by recording comments into the cells, which can then be played back. When the macro is started, it adds an "Audio" option to the menu bar, from which play and record can be selected.

The record option brings up a small graphical recorder, and audio can be added from the microphone, using the record button, or pasted in from the clipboard by selecting paste from the system-menu pulldown. The mini-recorder is useful for quick comments, while pasting is advantageous because the Digital Audio application can be used to record the file, and then to add effects to it.

The MIDI (Musical Instrument Digital Interface) player allows playback of MIDI files from a selected position. The MIDI player is actually a generic media player that can dynamically change its device type, depending on the type of file that is loaded. The device type determines

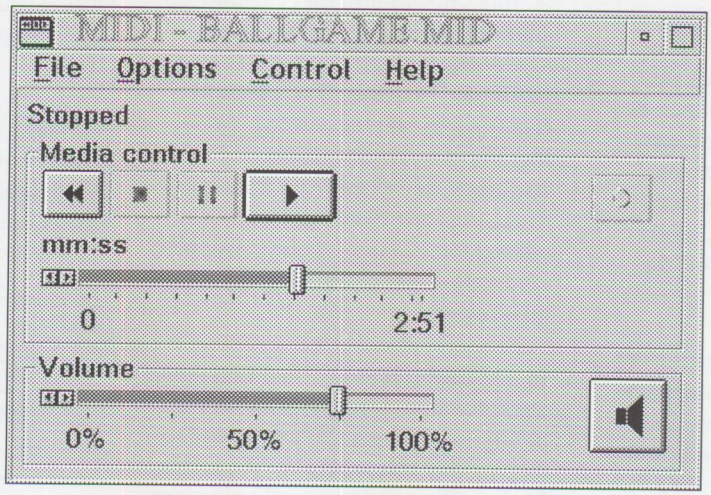

Figure 4. MIDI Player

whether record and other options are enabled (Figure 4).

System Sounds allow waveform files to be associated to different system events. This is both fun and educational — a favorite song clip could be played on startup, or audio help can be associated to actions, such as the shredder announcing that "This file will be obliterated if it is dropped here." System Sounds also recognizes files created using the OS/2 2.1 Tune Editor, which outputs DOS beeps at the appropriate frequency. Using the files composed of these DOS beeps enables system sounds to play through the computer's speaker, even if there is no sound card (Figure 5).

Except for the Tune Editor, the one thing common to all these audio applications is that they need to be played through an audio card in order to be heard. The three boards supported by MMPM/2 are the Creative Labs Sound Blaster** series (SB), the IBM Audio Capture and Playback Adapter* (ACPA or M-Audio), and the Media Vision Pro Audio Spectrum 16** (PAS 16). Figure 6 summarizes this information.

The PAS 16 also supports simultaneous playback of MIDI and wave audio. All SB (version 2.0 or higher) and SB Pro adapters are supported.

Additionally, multimedia-enabled REXX provides command-line or batch-file support for playing and recording sound, and for playing movie files. For example, a useful application would be adding the playback of an audio clip to the end of a compiled batch file to let the programmer know when the compilation is done.

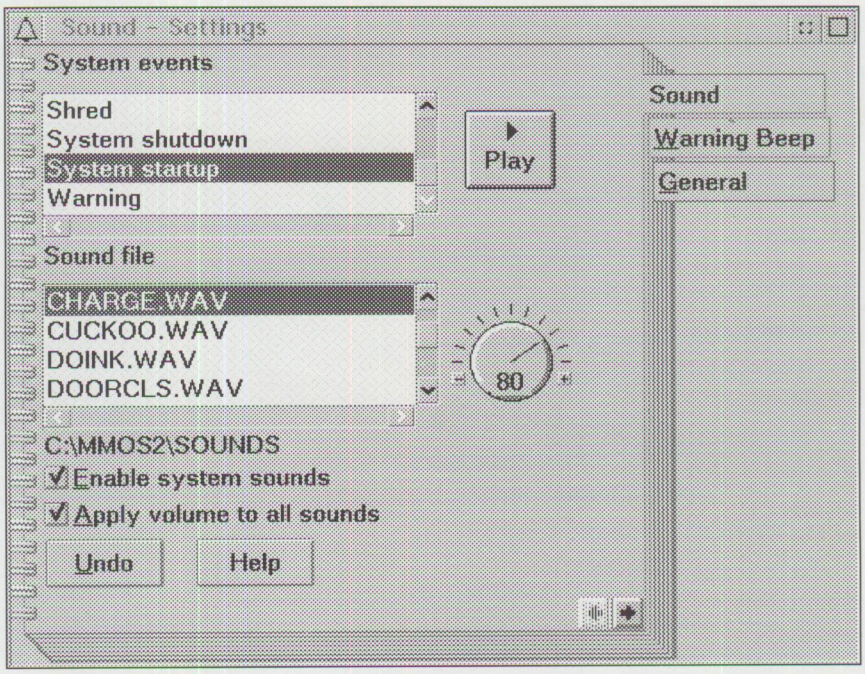

Figure 5. System Sounds

OS/2 2.1 Multimedia Video

The OS/2 2.1 MMPM/2-based applications that provide video support are:

- Digital Video Player
- Video In Recorder
- AVI File Utility
- Ultimedia Builder/2
- Ultimedia Perfect Image/2

Available as part of OS/2 2.1, the Digital Video Player plays software motion video movies. Because this playback is done in software, no additional video hardware is required. This means that anyone using an OS/2 2.1-based computer has the capability to play video.

When playing a movie, the generic media player interface is used as a control panel, and the movie is displayed in a separate playback win-

Card	8-Bit	16-Bit	Stereo	Mono	11.025 kHz	22.050 kHz	44.100 kHz
ACPA	X	X	X	X	X	X	X
PAS 16	X	X	X	X	X	X	X
SB	X		X	X	X	X	X(mono)
SB Pro	X		X	X	X	X	X(mono)
SB Pro 16	X	X	X	X	X	X	X

Figure 6. Attributes of Audio Cards Supported by OS/2 Multimedia

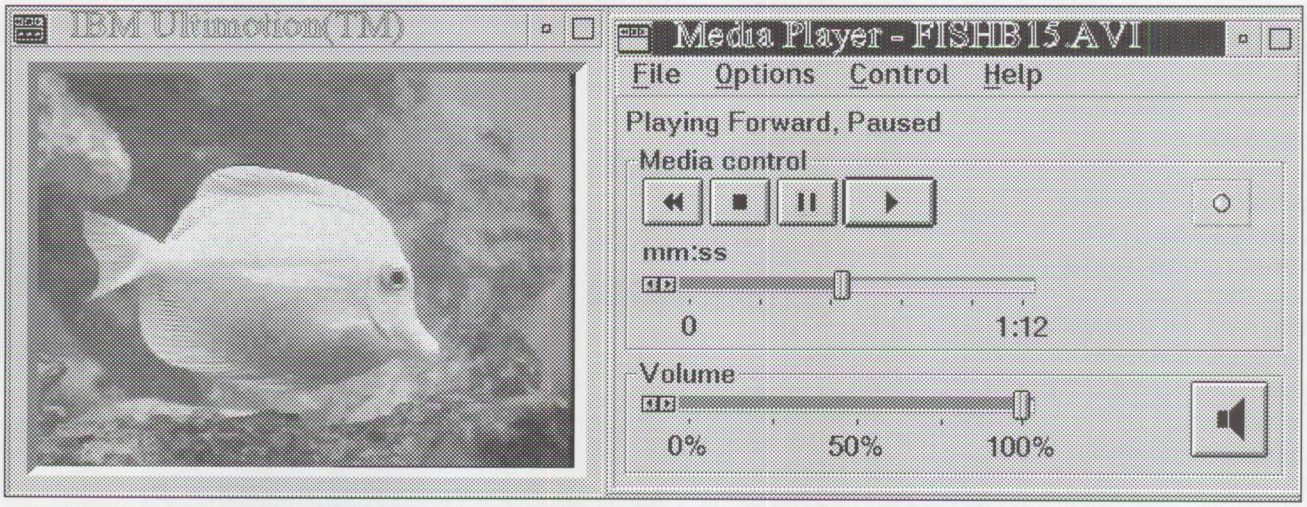

Figure 7. Digital Video Player

dow. This window's system menu contains several additional video-specific menu options. Under "Movie info", information is given about the file name, compression type, frame size, frame rate, data rate, and running time. Additionally, Double Size and Half Size are available on most SVGA and XGA systems. These options, for example, would make a 320 x 240 movie play at either 640 x 480 or 160 x 120 by adding or removing pixels respectively (Figure 7).

OS/2 2.1 software motion video uses the standard Audio Video Interleaved (AVI) file format. This format arranges audio and video data within a file. To conserve file space, this data can be compressed, and then rapidly decompressed for playback.

Algorithms that do this type of compression / decompression are called CODECs. Ultimotion* and Indeo** are those currently supported by OS/2 2.1 Multimedia.

While the OS/2 2.1 Digital Video Player can play movies, it cannot create, capture, or modify them. To do this, Video In, the most recent MMPM/2-based product, provides the Video In Recorder and the AVI File Utility. To create a movie, certain parameters have to be set before recording can take place.

The dimensions of the movie, or the frame size, are specified by width times height in pels. The maximum size is hardware-dependent; for example, 640 x 480 pels. The frame size of the movie is usually set as a ratio of these dimensions, say 2:1 or 320 x 240 pels.

Movies can be recorded in two ways: frame-step or real-time.

The frame rate is the number of frames per second (FPS) that are captured for playback. The actual rate of playback depends, however, on the processing capabilities of the system, as well as on the complexity of the CODEC used to create the movie.

The data rate needed for single-speed CD-ROMs, 150 KBS, is the data rate achieved when recording a 320 x 240 pel movie at 15 FPS with 64K colors.

Movies can be recorded in two ways: frame-step or real-time. Since frame-step capture steps through the video source frame-by-frame, the CODEC can spend more time analyzing the data. Therefore, better quality, compression, and data rate are achieved. Source input for frame-stepped capture must be either a computer-controlled device (such as a laserdisk) or an AVI file. Laserdisk support is provided for the Pioneer Laserdisc** models LD-V4200, LD-V4300D, LD-4400, and LD-V8000.

Frame-step recording from a source AVI file makes it possible to change the compression type of the data. Changing the compression type allows the conversion from one CODEC to another; for example, from Indeo to Ultimotion. Furthermore, it enables the compression of a "raw," or uncompressed video file, as well as the creation of a raw file from an existing movie. This capability is useful for editing together movies of different types, and for creating high-

quality compressed movies from raw video or animation.

Real-time capture is done from a live video source (such as a videotape device or camcorder) via line in, and it compresses the image immediately. Since less time is spent analyzing the source, the frame size and frame rate are typically smaller in order to achieve the same data rate as a video made using frame-step compression. This type of compression is ideal for situations that require video content to be captured in real time for immediate playback.

While recording, the video or audio source may be monitored to ensure that the correct video sequence is being captured. The video monitor can be used to reflect adjustments in brightness, color, contrast, and tint to be made to the recorded video. It is also possible to isolate a rectangular portion of the monitor video for video capture, by drawing this region directly on the monitor video window. This image-cropping can also be useful during bitmap capture. Here, the Video In Recorder captures the image in the monitor window, or inside the monitor window's crop region, into the 24-bit RGB OS/2 bitmap format.

After recording, the Video In Recorder can be used to edit the video, by marking regions to be cut, copied or pasted into the same video or other video files (Figure 8).

Since the actual video compression is done in software, only a simple "frame-grabber" card is necessary to capture the image. The video capture devices that are currently supported are: the Creative Labs Video Blaster**, IBM Video Capture Adapter/A* (VCA), Jovian Super Video Input Adapter** (SuperVIA**), Jovian Quick Video Input Adapter**

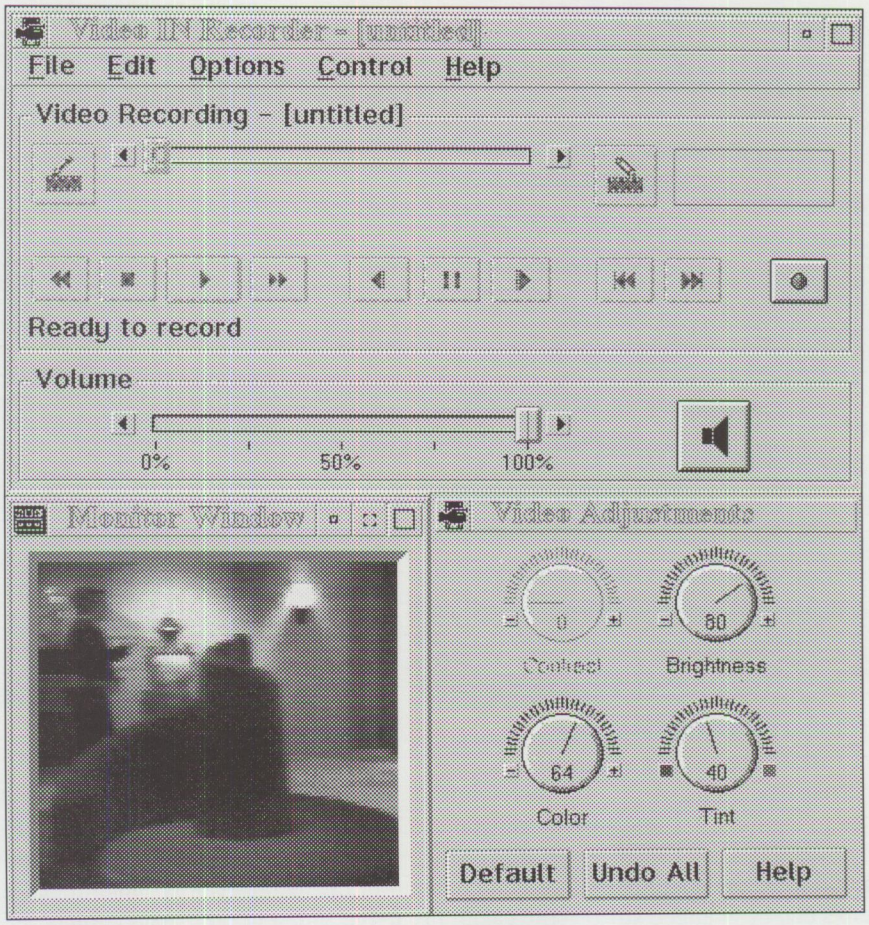

Figure 8. Video In Recorder

(QuickVIA**), New Media Graphics Super Video Windows (TM), Samsung Video Magic**, and the Sigma Designs WinMovie**. The attributes of these cards are listed in Figure 9.

The AVI File Utility is also included in the Video In product. This utility provides the ability to browse AVI file information, to manipulate the interrelation of audio and video within the AVI file, and to compose an animation from a series of images.

As an AVI file browser, the AVI file Utility can view information within the file, such as the header, the chunk ID and length, the index, and status. The utility enables viewing all these things at once, or isolating the view to just those items of interest (Figure 10).

During capture, audio and video are recorded separately, and then interleaved when the file is saved to form an AVI file. With this utility, the audio can be split from the video; audio can be merged into the video; the interleave ratio of video to audio chunks can be modified; and the skew between audio and video can be changed. Splitting audio from video and merging audio into video can be used together or separately to create silent movies or soundtracks, or to modify or change the audio associated with a movie.

Card	Bus	Format	Input	Size
Video Capture Adapter/A	MC	NTSC	Composite, RGB, S-Video	640 x 480
Video Capture Adapter/A	MC	PAL	Composite, RGB, S-Video	640 x 480
SuperVIA	MC, ISA	NTSC	Composite, S-Video	640 x 480
SuperVIA	MC, ISA	PAL	Composite, S-Video	640 x 560
QuickVIA	ISA	NTSC	Composite, S-Video	320 x 240
QuickVIA	ISA	PAL	Composite, S-Video	320 x 240
WinMovie	ISA	NTSC	Composite, S-Video	320 x 240
WinMovie	ISA	PAL	Composite, S-Video	320 x 240
Video Blaster	ISA	NTSC, PAL	3-Composite	1024 x 768
Super Video Windows	ISA	NTSC, PAL	3-Composite	1024 x 768
Video Magic	ISA	NTSC, PAL	3-Composite	1024 x 768

Figure 9. Video Capture Device Attributes

An ideal movie has one chunk of video to one audio chunk, a 1:1 interleave ratio. If a movie has a 1:1 interleave ratio, the skew between audio and video chunks can be changed so that the audio is stored before the corresponding video in the AVI file.

This helps to ensure that the audio buffers will remain full as the movie plays, and that frames are not dropped as a result of trying to maintain audio continuity.

In addition to AVI file manipulation, the AVI File Utility enables the creation of "raw" AVI movie files, or animations, from a series of images. These images need to be of equal size, and can be any combination of the supported image types. This includes the image types supported by MMPM/2 in OS/2 2.1, and those supplied by Perfect Image/2. The images and any pauses are placed in the order to be recorded, and the frame rate is specified. From this source information, a "raw" AVI file is generated. Compression can be achieved by bringing this raw file in as source input for the record-from-file capability in the Video In Recorder. If desired, a soundtrack can then be added by using the AVI File Utility. Thus, a full animation could be created using bitmaps that are output from animating packages, bitmaps created from the Video In Recorder, bitmaps altered using Perfect Image/2, or from any number of other places.

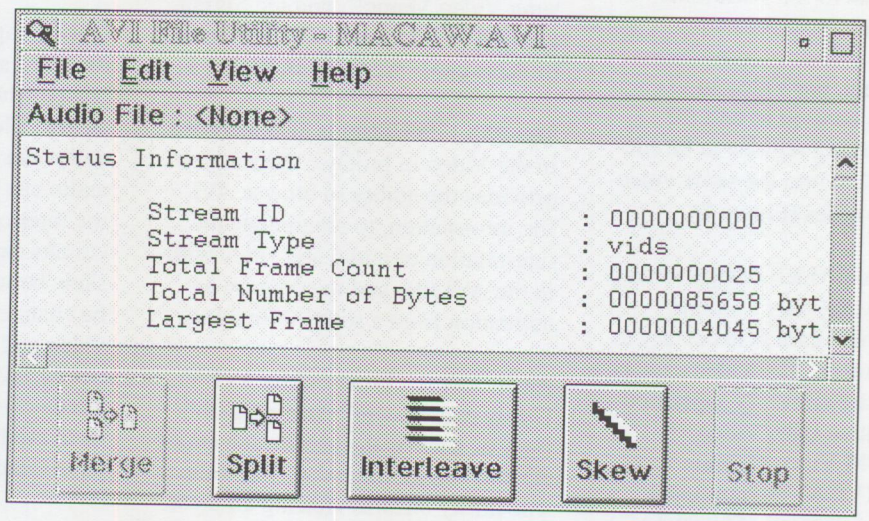

Figure 10. AVI File Utility

Going Further with OS/2 2.1 Multimedia

OS/2 2.1 Multimedia, with its ability to fully utilize the OS/2 2.1 architecture, and its support of Workplace Shell functions, such as drag-and-drop, enables the user to immediately extend his or her everyday operations into the realm of multimedia. Video In, with the Video In Recorder, and AVI File Utility applications provide the ability to create video material to be used by OS/2 2.1 Multimedia.

To go beyond these capabilities, Ultimedia Builder/2 and Ultimedia Perfect Image/2, which are both MMPM/2-based products, enable the integration of audio, image, and video to create presentations, and the ability to edit images, respectively.

The OS/2 2.1 Toolkit, which includes the OS/2 2.1 Multimedia toolkit, in conjunction with the Video In multimedia toolkit additions, has header files and libraries needed to program new OS/2 2.1 multimedia applications or extensions to the MMPM/2 architecture. Usable samples and corresponding C-language code give examples for programmers to follow.

Not only does OS/2 2.1 Multimedia provide multimedia applications for use today— MMPM/2 ensures extension of multimedia into the future!

Maria Ingold *is a programmer and resident artist for OS/2 2.1 Multimedia and Video In. She worked on the Multimedia Data Converter and Digital Audio/Player/Recorder "applets," as well as several of the Video In subsystems. She received her B.S. in computer science, with a studio art minor, from the University of New Mexico. Part of her studies were done at the University of Essex, U.K. Reach Maria via Internet at ingoldm@bcrvmpc2.vnet.ibm.com.*

Glossary

ACPA	IBM Audio Capture and Playback Adapter.
ADPCM	Adaptive Differential Pulse Code Modulation.
AVI	Audio Video Interleaved, a file format that arranges audio and video data chunks in a file.
CODEC	COmpressor/DECompressor, the algorithm by which an image is compressed and decompressed in hardware and/or software.
DSP	Digital Signal Processor.
FPS	Frames Per Second.
ISA	Industry-Standard Architecture.
Interleave	In this context, the combining and synchronizing of audio and video data.
KBS	Kilobytes Per Second.
kHz	Kilohertz, thousands of cycles per second.
M-Audio	See **ACPA.**
MC	Micro Channel architecture.
MIDI	Musical Instrument Digital Interface.
MMPM/2	Multimedia Presentation Manager/2.
NTSC	National Television Systems Committee, the television standard for the United States.
PAL	Phase Alternating Line, a European television standard.
PAS	Pro Audio Spectrum.
Pels	Also referred to as **pixels**. Both acronyms were derived from the words "picture element." On a display, a pel is the smallest element that can be independently given both color and intensity.
PCM	Pulse Code Modulation.
Raw Movie	An uncompressed AVI movie file.
RGB	Red, green, blue.
RIFF	Resource interchange file format.
SVGA	Super Video Graphics Adapter / Array.
S-VIA	Jovian Super Video Input Adapter.
VCA	IBM Video Capture Adapter.
Waveform	The digital representation of audio (sound waves).
WPS	Workplace Shell.
XGA	eXtended Graphics Array adapter.

References

IBM Multimedia Presentation Manager/2 Application Programming Guide, Release 1.1, IBM Corporation, 1993.

Ultimedia Video In User's Guide, Release 1.0, IBM Corporation, 1993.

Maximizing OS/2 2.1 Multimedia Performance

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One of the more intriguing additions to the OS/2 2.1 operating system is its ability to integrate sound and video with your everyday activities. This multimedia support, called Multimedia Presentation Manager/2 (MMPM/2), also comes with CD Audio, CD XA (eXtended Architecture), and Musical Instrument Digital Interface (MIDI) capabilities. Although MMPM/2 installs very easily, its defaults may not be optimal for your system; it is possible to tweak a few settings to obtain better performance, as this article demonstrates.

When you install MMPM/2, a multimedia folder is created on your desktop. In it, you will find the multimedia setup program (see Figure 1). This setup program allows you to manipulate some key features, such as the location of all multimedia temporary files.

The System tab in the setup applet lets you change the work path (or location) of all multimedia temporary files. This work path is used whenever you record digital audio files, use digital audio clipboard operations, and record video with the Ultimedia* Video In product.

It is essential that you put the work path on the disk drive that has the most free space; preferably, this disk drive should be your fastest drive as well.

The Compact Disc tab in the setup applet allows you to change the drive letter that your CD-ROM is located on. For instance, this tab can be used to inform MMPM/2 when the drive letter for your CD changes after you install or remove a hard drive.

Digital Audio Tips

Before OS/2 2.1, the OS/2 desktop was not multimedia-aware. Yes, you could add a bitmap and some interesting icons, but the desktop remained silent. By adding a sound card to your computer system, the Workplace Shell really comes alive. For instance, if you have OS/2's built-in sound effects active, or you are running System Sounds for OS/2 from Bocasoft, then Golden CommPass**, a CompuServe navigator, no longer emits a mere beep when it finishes downloading a file; rather, it rings a bell — truly a more lively way to do your work!

If you are still evaluating the purchase of a sound card, OS/2 2.1

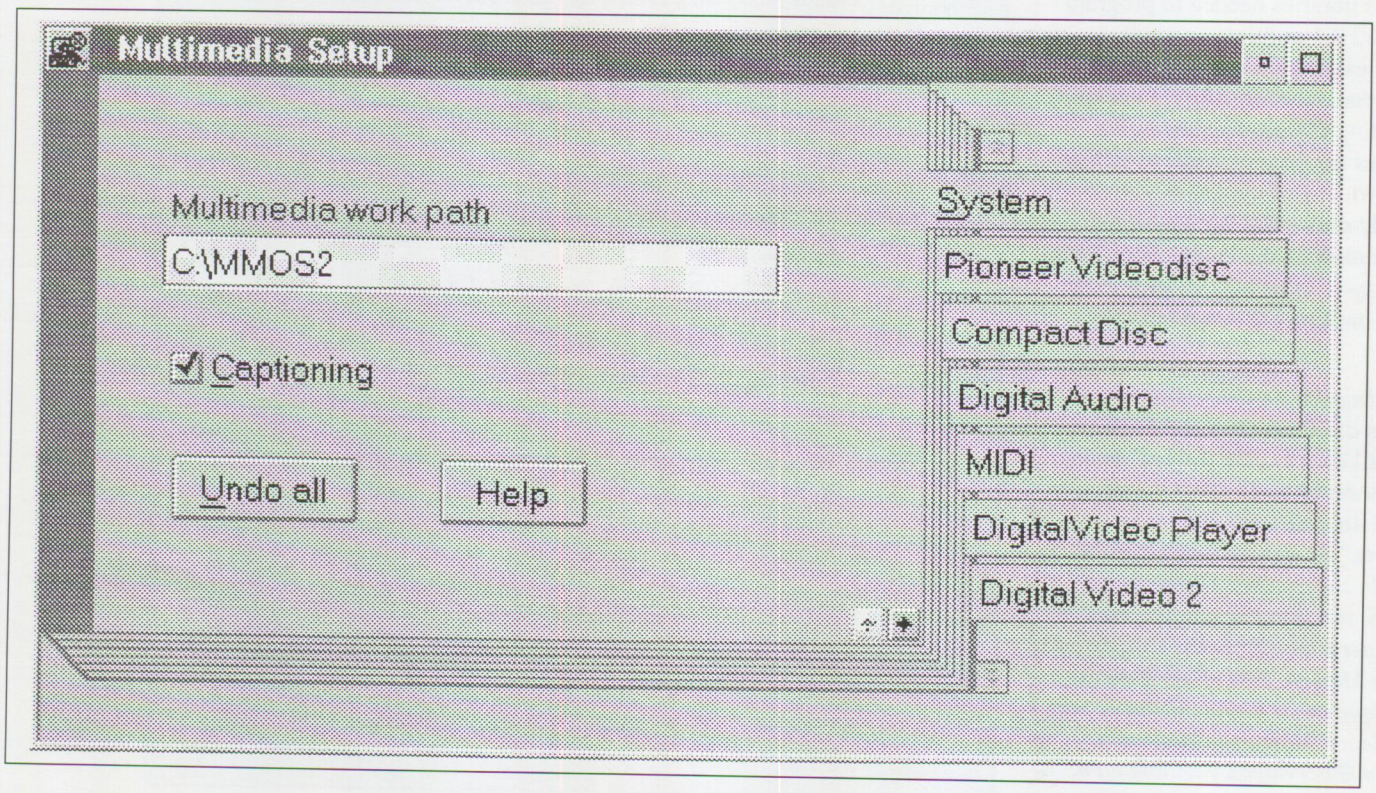

Figure 1. Multimedia Setup

comes with support for the Media Vision Pro Audio Spectrum 16**, Pro Audio Studio**, Pro Audio Basic**, IBM M-Audio*, Creative Labs SoundBlaster**, SoundBlaster Pro**, SoundBlaster 16**, and SoundBlaster 16 ASP**. For users of portable computers (or systems with no free slots), beta drivers are available for the DSP Solutions Portable Sound and Arkay** Technologies Plug-N-Play** parallel port devices. Furthermore, OS/2 drivers for the business audio chip on the ThinkPad* 750 will be available in the future.

If you already have a sound card, you can improve its performance with OS/2 2.1 by taking advantage of the tips below.

Media Vision Hardware: The Pro Audio series currently has some of the highest functionality of any OS/2 audio devices. This series of sound cards supports simultaneous playback of MIDI and digital audio, enables a large number of applications to use audio, and supports a full-function OS/2 mixing application (which is available on CompuServe).

If you own any of the Pro Audio series, and you want to have audio in WIN-OS/2 in addition to OS/2, it is recommended that you install the Thunderboard** drivers in WIN-OS/2. These drivers enable you to simultaneously have music in the Windows session while running an unlimited number of OS/2 audio programs (such as Ultimedia Builder**). If you choose to install a Pro Audio driver in WIN-OS/2, you will not be able to use sound in both OS/2 and WIN-OS/2 simultaneously.

The Pro Audio driver shipped with OS/2 2.1 has a few bugs with DOS games. Media Vision has an update for this driver on CompuServe (enter GO MEDIAVISION), which fixes problems with game termination, MIDI sound, and other items.

Creative Labs Hardware: SoundBlaster cards can be difficult to configure in certain computer systems. After driver installation, you may hear constantly repeating sounds, or find that you cannot print. These situations are caused by an interrupt conflict — SoundBlaster cards come factory-installed to use INTerrupt 7, which is the same interrupt that OS/2 uses for printing. Therefore, you are advised not to install SoundBlaster drivers on this interrupt.

If you are experiencing problems, the best interrupt and input/output (I/O) address to try first is INTerrupt 5, I/O address 240. After you have changed the hardware settings on the card, you must update the settings for the SoundBlaster driver in CONFIG.SYS. The documentation for the CONFIG.SYS settings is in the README file in the \MMOS2 directory.

If you see a SYS1201 error when you reboot after installing the SoundBlaster drivers, you probably have an older SoundBlaster card (that is, at a 1.0 level). The OS/2 drivers require the SoundBlaster drivers to be at least at level 2.0. You can contact Creative Labs at 1-405-742-6622 to obtain the necessary upgrade.

Creative Labs is well known in the sound-card market, and a large number of DOS games work with their devices. Most games play without problems under OS/2, although some games experience problems with speech and other multimedia features. If you encounter these kinds of problems, go to the DOS settings for the application, and turn Interrupt During I/O to ON. This may avert the difficulties.

SoundBlaster Compatibles: There are several alternatives for owners of SoundBlaster-compatible cards that do not work with the OS/2 SoundBlaster driver. ATI SoundFX owners should upgrade their BIOS to at least level 2.09. Several users have reported success with this BIOS level. For Thunderboard owners, Media Vision has patched SoundBlaster drivers that work with the Thunderboard (and probably with other compatibles as well). Although these drivers may work with your system, they are not supported by IBM technical support; you should contact your manufacturer to obtain native OS/2 drivers.

Digital Video Suggestions

One of the most revolutionary additions to the OS/2 2.1 operating system is the inclusion of 32-bit, high-performance software motion video support. On the OS/2 2.1 CD-ROM, there are movies in both Ultimotion (one of the most sophisticated software motion video algorithms in the industry) and Indeo formats. Although these movie files will play back on any OS/2-capable machine (even a 386 SX) without expensive graphics hardware, a 33 MHz 486 is recommmended to achieve high frame rates and large picture sizes.

Besides processor power, another key factor affecting the performance of software motion video is the graphics display. If you have an XGA display, an S3**-based display (with 32-bit display drivers), or a supported SVGA adapter with 32-bit display drivers, you have a workstation capable of very smooth Ultimotion playback. By contrast, if your computer does not have a supported 32-bit display driver, or you are running your card in 8514 compatibility mode, performance will be less than optimal. This happens because the 32-bit

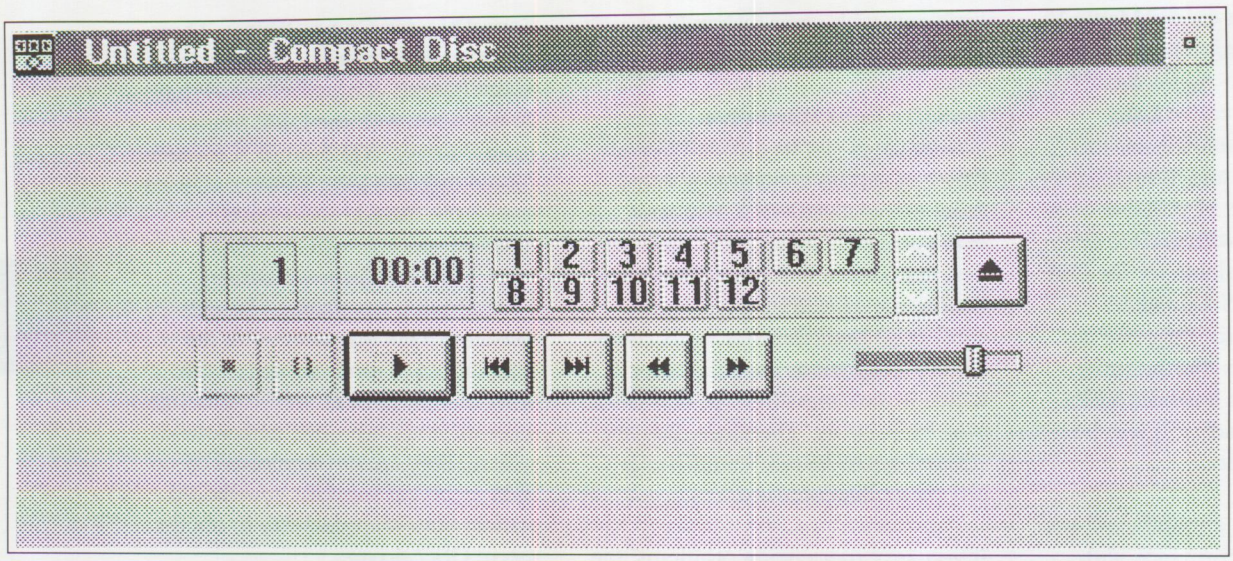

Figure 2. CD Player

display drivers have special hooks to accelerate Ultimotion performance. If you don't have accelerated display drivers, contact your card's manufacturer.

Another key to good movie playback is a high-performance CD-ROM. If you are looking for a CD-ROM drive, a double-speed, SCSI-based CD-ROM drive (such as the IBM Enhanced CD-ROM II or the Toshiba 3401-B) can play back very large Ultimotion videos without problems.

For users constrained by budget, there are many low-cost CD-ROM drives (such as the IBM ISA CD-ROM drive or the Sony CDU-31a) that can also be used with OS/2. Unfortunately, the drivers for these CD-ROM drives must constantly poll (or request) for data, rather than interrupt the processor when data is ready. As a result, considerable processing time is taken away from the movie playback engine. IBM recognizes this problem, and will provide a fix in the future. Until the fix is available, these polling CD-ROM devices (which also include SCSI-based CD-ROM connected to Media Vision cards) will not offer optimal performance for multimedia programs, but are excellent for CD audio or data retrieval.

CD Audio Tips: OS/2 2.1 has greatly increased the support for CD-ROM devices (see the list in Issue 1, 1993 of this publication). In addition, MMPM/2 has enhanced its support of these additional drives. Previously, you could use only the IBM CD-ROM I or II with the CD Player. Now, all OS/2-supported CD-ROM drives can be used with the CD Player (see Figure 2).

The CD Player has also been updated to support a digital transfer option. Digital transfer allows data to be sent over the SCSI bus to the audio card in your system. This is useful when the digital/analog (D/A) converter in your sound card is much better than the D/A converter in your CD-ROM drive. The digital transfer option is available only if you have a 16-bit SCSI interface, a 16-bit audio card (such as Pro Audio Spectrum or SB16), and a CD-ROM drive that supports this option (such as the IBM Enhanced CD-ROM II or Toshiba 3401).

One word of caution: Digital transfer can consume very large quantities of processor time, so don't use this option while you are compiling a program or crunching numbers in a spreadsheet.

Conclusion

OS/2 provides a world-class multimedia environment. It offers unparalleled support for software motion video, digital audio, and CD audio support. Although all of these features are available immediately after installation of OS/2, if you tweak a few settings and optimize your hardware, MMPM/2 can become much more exciting!

Linden DeCarmo *joined IBM in 1991, and is a Senior Associate Programmer in multimedia software development. He is currently involved in Workplace OS multimedia development. Linden holds a BS in computer science and BBA in business management from Southern College, and an MS in computer science from the University of Miami. He can be reached at Internet userid lad@vnet.ibm.com.*

IBM Shows Off OS/2

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This article is a report about events at a monthly meeting of the Sacramento PC Users Group.

John Soyring, Director of Software Development Programs at IBM, began by pointing out his Borland (yes, Borland!) jacket. Borland had just held an international conference in San Diego, and John had been there working with Philippe Kahn.

Shedding the jacket, John revealed a T-shirt that said "NT" — which stood for "Nice Try." The back read "OS/2 — The difference between up and running and up and coming." The jacket lets the world know that OS/2 is still around, and that another, nameless operating system is not going to easily take over the world. This is indicative of the more aggressive posture IBM is taking.

2.1 and Beyond OS/2

John said that OS/2 is now available in three formats: diskettes, CD-ROM, and electronic copies for sending around networks. It has the capability of supporting up to 16 million colors on the palette.

If you are running Windows under OS/2, and encounter GPFs (General Protection Faults), the system keeps on running instead of having to be rebooted. There is more real and extended memory. Support for CD-ROM is also built in, because installation requires about 28 floppy disks versus one CD. There are added multimedia capabilities, and OS/2 2.1 is the first operating system that exploits the Pentium chip.

IBM is investing in four operating systems: DOS, OS/2, AIX*, and a new system called the Workplace Operating System. For the 25% of DOS users who prefer the C: prompt, OS/2 allows up to 240 C: prompts running concurrently.

OS/2 was built to exploit the capabilities of Intel 32-bit processors. Where DOS serializes I/O operations by issuing a single request at a time, OS/2 can use the Adaptec SCSI for up to seven concurrent I/O operations. The minimum memory on many PCs shipping today is 4 MB or 8 MB. DOS addresses the first megabyte, and then uses extenders to get up to 16 MB. With OS/2, you can get up to 512 MB, with a capability to address 2 GB of memory.

OS/2 is now available in three formats: diskettes, CD-ROM, and electronic copies for sending around networks.

The RISC System/6000* from IBM runs the operating system AIX. This same processor will be used in the future by Apple, Wang**, Bull, and others. The chip, called the PowerPC, is produced by Motorola**.

IBM and Apple are working toward this compatible CPU via a joint development effort, code-named Power Open. The AIX system will include the API toolset to allow Apple Macintosh applications to run in AIX, all on a PowerPC chip that also utilizes the Macintosh GUI (Graphical User Interface). Another goal is a UNIX system that will run Macintosh applications with a choice of two GUIs: OSF's Motif or the Mac's GUI.

Fourth in IBM's systems list is the Workplace Operating System, a new operating system that is portable across RISC and Intel. Sun has been very successful with SPARC, and HP with their Precision Architecture; Digital has introduced the Alpha (a 64-bit processor), and there are other RISC workstation providers. The Workplace Operating System will take advantage of this market.

IBM's OS/2 development is designed to allow it to be common across all four operating systems. The kernels are different, so you can run existing applications, but there will be a common workplace shell. Hewlett Packard, Novell**, SCO (Santa Cruz Operations, a UNIX vendor), and IBM announced that they will be implementing a common set of technologies, with a consistent interface, across all their UNIX platforms.

The plan is to make users independent of the operating system. The Workplace Operating System is designed to run on 16- and 32-bit processors. It will also run on a variety of 32- and 64-bit RISC processors. They are also designed to run symmetric multiprocessing, or multiple similar processors, all sharing the same memory, and executing a single copy of the operating system. The technology of the individual processor is improved, but multiple processors can then be added.

IBM wanted to find out which operating system would achieve four key objectives. First of all, it must run on

symmetric multiprocessing boxes. Second, it must be portable to a variety of RISC and Intel processors from a variety of vendors. Third, it must comply with the US Department of Defense security requirements. Finally, it must be *open*.

The best choice was originally developed as the Mach. This IBM microkernel is derived from the research of the Mach 3. It does support symmetric multi-processing, and performance keeps improving as processors are added. It is also highly portable. The microkernel has only 70,000 to 80,000 bytes of code, meets the security requirements of several governments, and is very open. Not only are the APIs documented, but the source code is available for vendors.

Above the microkernel is hardware-independent code — code that can be recompiled when moved from one processor to another. IBM is building a set of device drivers, a set of common system services such as a file system, and then (for the benefit of the psychologists in the audience) a set of personalities.

One personality will run DOS or Windows applications. Another will run 32-bit OS/2 applications. A third will run UNIX applications, and a fourth will run Taligent** applications. They can be installed individually or in multiples, in which case one is dominant and the others subservient. The combinations allow you to run DOS, Windows, and 16-bit and 32-bit OS/2 applications concurrently, plus UNIX and Taligent.

John believes that "a lot of the new applications will come out of object-oriented technology." The end-user's object-oriented GUI will be derived from the Workplace Shell. In this interface, icons will actually represent objects. Double-clicking on the icon could start up any operating system and application. Data will be associated with the program, so that you can manipulate the objects on the screen and perform actions directly on those objects without having to invoke or read menus.

OS/2 Multimedia

IBM's plans are to evolve and continue to refine and extend OS/2. Included is MMPM/2 (Multimedia Presentation Manager/2). The capabilities in OS/2 are a superset of what used to be in Windows' Multimedia Extensions.

The combinations allow you to run DOS, Windows, and 16-bit and 32-bit OS/2 applications concurrently, plus UNIX and Taligent.

The media control interface is consistent with what Microsoft has in its Windows multimedia extensions, because it was built to the same specs. It supports the same file formats, but it will let you do things you can't do under Windows. For example, the audio file can be separate from the video file. This is good for creators of full-motion video who want to dub in different languages. Other OS/2 features include a Pen interface and Touch interface support. There is continuous speech recognition, a 20,000-word vocabulary, and distributed computing.

IBM is also enhancing the LAN Server by working with Novell on new versions of NetWare**. Most LANs today create islands of automation, where the technology won't meet the needs of tomorrow. With OS/2, you will be able to connect entire enterprises or multiple enterprises as though they were one big LAN.

Finally, application developers can create applications using distributed object technology. Object technology is the biggest area of breakthrough for programmers. IBM has included a System Object Model (or SOM) that will become the breadboard of the software industry. The industry has not had a proper breadboard with proper pin-spacing to plug in components. The voltage levels of all these components have been different. Some use 3, 7, or 10 volts, and parts from different vendors could not be plugged together to create applications. Now, components with 3 to 4 million software instructions can be created, shifted into binary format, converted into any language, and connected with components by other vendors.

Barnes Brings Down the House

Speaking to an audience immediately after an executive of an IBM division would be quite a challenge. David Barnes, from IBM's Executive Briefing Center in Boca Raton, Florida, came out shooting.

First he described his job. "IBM gives me hardware and software. I play with it. They pay me!" he said. "It gets better: I ask other companies to send me software, and they do!"

Dave launched into his presentation of OS/2 version 2.1. He said that the newly revised operating system had never hung up on him. He also emphasized that OS/2 2.1 is also much faster.

In response to a question from the audience, Dave said he was running the demonstration on a 486/33 with 16 MB of memory. "By the way, I like 8 megs for OS/2," he said. "It will run in 4 or 6, but I like 8."

On the large screen over the stage, the audience watched as Dave showed OS/2's Workplace Shell. It resembled MS Windows, but without the menu bar across the top.

He emphasized that it was created using object-oriented technology. Everything on the screen is an object, and OS/2 acts on every object the same way. Clicking with the left mouse button selects the object (an icon, for example) under the mouse pointer. Clicking with the right mouse button produced a pop-up menu for the item to which the mouse was pointing. "You'll see that everywhere in OS/2," Dave said. Even the desktop itself had a pop-up menu.

Dave pointed out that pop-up menus appear in all OS/2 applications, as well as in the Workplace Shell itself. On every one of those pop-up, object-oriented menus, there was a Help option, regardless of which OS/2 program was running.

Multithreading Versus Multitasking

Dave moved on to talk about the multi-threaded nature of the OS/2 2.1 operating system. To accomplish subroutines (tasks that are not part of the main program), most operating systems have to branch and return. There is always a single path or thread that the program follows. In contrast, OS/2 spawns a new thread to perform subroutines. The main program sends the subroutine off to do a task while the main program continues to execute.

"I can have up to 2,000 threads running concurrently," Dave said. To demonstrate the multi-threaded nature of OS/2, Dave launched a number of programs. After he clicked each one, the mouse pointer immediately reappeared — even though the programs weren't finished loading. The programs were separate threads that ran concurrently, making the hourglass's appearance a rare occasion.

The main program sends the subroutine off to do a task while the main program continues to execute.

If a user prefers the C: prompt instead of Presentation Manager, it can be loaded as the main OS/2 interface by changing the SHELL statement in OS/2's CONFIG.SYS file to CMD.EXE, then rebooting. For the Presentation Manager, type PMSHELL in the SHELL statement. "It's extensible, in that if you don't like this Presentation Manager, you can write your own," Dave said. "A lot of customers create mini-shells."

Next, Dave wanted to change the icon of an object on his desktop, a folder called Flyer. He called up a menu with a right-click on the object, chose one of the menu options, and dragged another icon from the desktop. The new icon copied to the document. He pointed out that this was much easier than the 12 steps required for the same task in MS Windows.

Dave opened the Flyer folder with a double-click. He then launched an automated graphics application called Popeye. With Popeye's head spinning in a window, Dave pressed Alt-Home and converted the still-moving graphic to a full screen. A second Alt-Home command converted it back to a window. "By the way," Dave added, "That's well over a megabyte of data in the Popeye program."

Dave mentioned data produced by 3-D Benchmark, a program that measures the video speed. He used it to compare speed on his system in full-screen DOS sessions versus DOS windows under OS/2. In full-screen, his machine benchmarked at 15.1. In a window, it benchmarked at 14.8. His point was that OS/2 does an incredible job running DOS applications in an OS/2 window.

Why Eight-Dot-Three?

Switching focus, Dave reminded the audience that DOS's eight-dot-three file naming convention was a holdover from its origins in CP/M. In contrast, OS/2, using the High-Performance File System (HPFS), allows 254 characters for file names or directory names. Dave further explained that OS/2 shows DOS only the first eight characters of its file names.

With the DOS-based Popeye video program still running, Dave launched an OS/2 program. He said that Windows NT does not multitask DOS applications very well, "and it even says so in NT's README file." Dave repeatedly asserted that OS/2 runs DOS programs better than native DOS.

While on the subject of Microsoft operating systems, Dave took the opportunity to challenge Microsoft to a head-to-head demo of OS/2 versus

NT in front of the Sacramento PC Users Group. "We're going to be doing it at HAL PC, and I'd love to come back and do it for you," he offered. The crowd roared its acceptance. *Editor's note: A PC user group member's account of the HAL-PC shootout immediately follows this article.*

Moving on, Dave showed how OS/2 programs have no file extensions, yet he was able to launch an application by double-clicking on the name of a document. In MS Windows, this is done by associating the filename extension with a program. OS/2 automatically associates the document with the program when it is created. Users can easily change the associated program.

Dave then copied the screen of the Popeye program to the OS/2 clipboard. Other DOS applications kept running while this happened. The Popeye program did not pause either. "Your DOS program, sitting in a Window, can run while you do other things."

Pasting the clipboard frame of the Popeye video into a newsletter created using DeScribe, Dave pointed out that he was cutting and pasting from a 16-bit DOS application to a 32-bit OS/2 application. He said that OS/2 can do cut-and-paste between any combination of OS/2, DOS, and MS Windows applications. He further demonstrated this by copying from WordPerfect 5.1, which was running in a DOS window, into the newsletter in DeScribe, an OS/2 application. He did all this with the mouse and without any WordPerfect commands.

Dave said that OS/2 can run the brand-new MS DOS 6 in a window. He then typed the DOS MEM command in the DOS 6 window. "Out of 640 KB of maximum available memory, I've got 753 K!" He explained that he changed the OS/2 settings for that DOS session to reclaim the memory that would normally be used for VGA graphics capability. With VGA video and TSRs loaded into his normal DOS sessions, Dave said he got 647 K. He added that NT doesn't give DOS applications any settings to accomplish this.

Your DOS program, sitting in a Window, can run while you do other things.

He demonstrated the ease with which users can change font size for a DOS session. He claimed you could run six copies of WordPerfect, all at the same time. Although you couldn't see them all at once, Dave claimed OS/2 could run 240 copies of WordPerfect — if the hardware could handle it.

OS/2 offers a Close option for each window. Dave showed that this was better than using the old DOS or MS Windows command of Ctrl-Alt-Del to get rid of a bad DOS session. OS/2 completely kills that particular DOS or MS Windows session without affecting any other progams.

Dave closed one window while opening another at the same time. "That's impossible in DOS and in MS Windows and the Mac," he said. He then had DeScribe print its document. The mouse cursor immediately reappeared. Because of multithreading in OS/2, Dave said he could immediately begin editing the same file that was printed.

Dave then showed how OS/2 handles DOS and MS Windows applications. He started Gary Larson's "Far Side Calendar," an MS Windows program. He said that OS/2 creates a virtual x86 processor, loads a copy of DOS, loads a copy of MS Windows, then opens the application. He added that the virtual versions of DOS and MS Windows 3.1 operating systems are included on the diskettes that come with OS/2.

Dave Barnes' presentation was brought to a premature close because 10 p.m. was rapidly approaching. In spite of the late hour, a heavy majority of the evening's audience were still in their seats — and free software was not the reason. Those of you who weren't there missed the finest presenter the group has seen in a long while, operating at the peak of form.

Shootout at the HAL-PC Corral

David Matocha
Houston Area League of PC Users
Houston, Texas

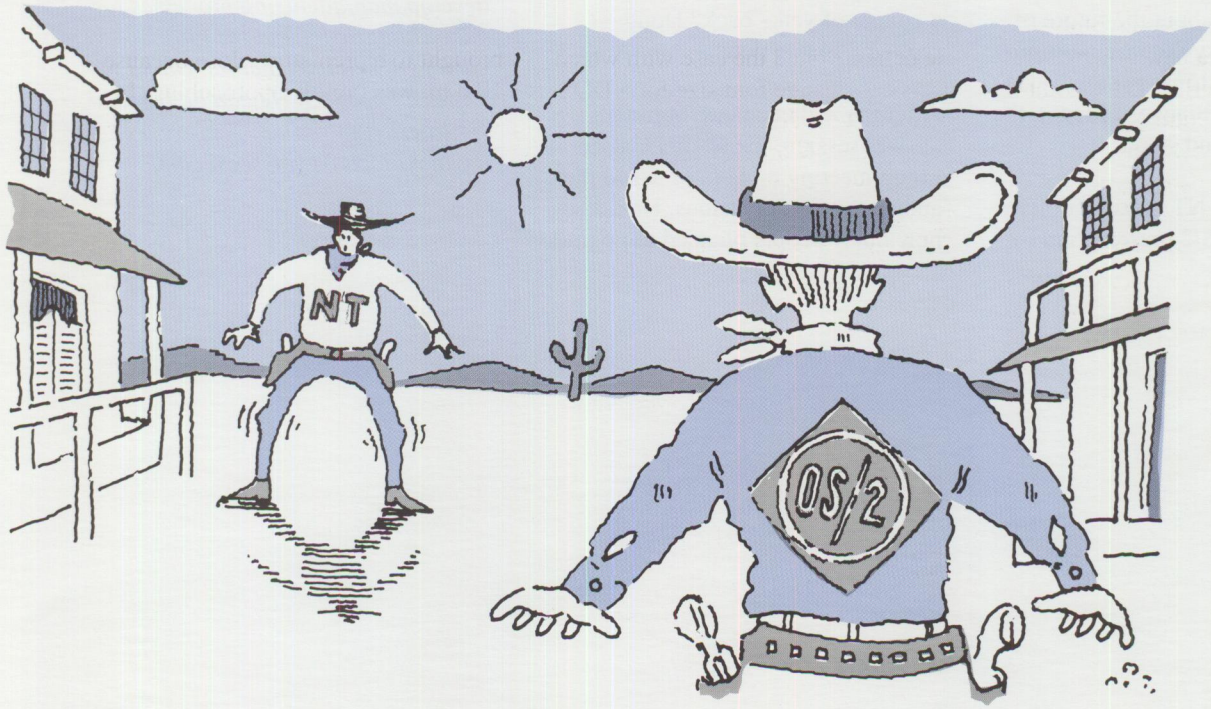
HAL-PC, the Houston Area League of PC Users, with over 10,000 members the second-largest users group in the U.S., staged a Windows NT versus OS/2 shootout, with presentations by Microsoft and IBM. In true Texas tradition, these shootouts feature head-to-head comparisons between competing products. As in an Old West shootout, one competitor walks away with his head held high, while the loser ends up face-down in the dust. Such was the case in Houston.

The audience consisted of a standing-room-only crowd of approximately 1300 people, representing a cross-section of HAL-PC members and guests. Microsoft's Doug Davis, of the NT development team, spoke first, and began his presentation with a set of slides presented from a 486/66 Mhz PC running NT, followed by a brief tour of NT itself.

Mr. Davis did not demo any DOS or Windows 3.x applications running under NT. He did show how a user could change the mouse pointer from the standard MS arrow to an arrow with a wiggling tail, or to Doug's favorite, a galloping horse. Doug referred often to NT's security and system administration features. During the NT presentation, I kept thinking that NT looked a great deal like UNIX, with a Windows interface. The other impression that the Microsoft presentation left was that NT appeared fat, slow, and boring... something that only a network administrator could love.

The OS/2 presentation by David Barnes of IBM was entirely devoted to a tour of OS/2 2.1. David's presentation on a 486/33 machine with 16 MB was lively and animated (literally). He first started an animated graphical DOS application called Popeye in a window on the OS/2 desktop. While pointing out to the audience that NT cannot run graphical DOS applications in a window, he opened various Windows and OS/2 applications, and pointed out that the hourglass never appeared, and that the DOS application Popeye never missed a beat.

David showed Windows 3.x applications, DOS applications, and OS/2 applications, including WordPerfect for DOS, the Far Side Calendar for Windows, DeScribe 4.0 for OS/2, and miscellaneous other applications, all running simultaneously on the desktop He captured the graphical screen image from Popeye, and pasted it into a DeScribe document, while pointing out that the DOS application Popeye continued running, even while the graphics screen was frozen for the clipboard copy.



David also created a simple OS/2 application from scratch in about five minutes, using drag-and-drop methods on Digitalk's Parts product. Without typing any code, he created a control panel with a slider, a twist knob, and a visual display, which was linked via DDE to a Lotus for OS/2 worksheet. A pie chart from the worksheet had been linked to a Describe document earlier in the presentation. As David manipulated the slide or knob with the mouse, the digital display would update, the corresponding cell in the Lotus worksheet would update, and the pie chart in the DeScribe document would redraw. The key point in this portion of the demonstration was that this entire procedure was accomplished without writing any code, and it was done live, in just a few minutes. Very impressive!

Unlike the MS presentation, the IBM presentation was interrupted by frequent applause. The noise level in the hall continued rising as neighbors discussed the points that IBM was making. Not even a lockup could slow things down. David shifted gears and talked about the future of OS/2, including symmetric multiprocessing (planned to be out this year), the Apple-IBM alliance, Taligent, the Workplace OS, and so on.

In contrast to the NT presentation by Microsoft, the OS/2 presentation by IBM was lean, fast, and exciting. The OS/2 multimedia presentation brought down the house. It was *great!* At several points, there were two real-time video plus soundtrack pieces running on screen, simultaneously, without video hardware assist. I was very impressed.

I only wish that Bill Gates could have been there to see it with his own eyes!

At the end of the presentations, there was a question-and-answer session. Many constructive questions were directed toward IBM. The MS representative, on the other hand, got grilled. One guy asked Microsoft's representative, Doug Davis, a hypothetical question: If NT sales do not live up to Microsoft's expectations, would Microsoft change direction and drop NT like they did with OS/2 a couple of years back? Doug replied: "I hope not."

After the audience question-and-answer session, the HAL-PC user group meeting moderator asked the audience a few questions. He asked how many people planned to upgrade to OS/2 2.1 right away. Hundreds of individuals — about half the people in the audience — raised their hands. He then asked how many people planned to move to NT. I saw *only two people* raise their hands. Out of 1,300, *two!*

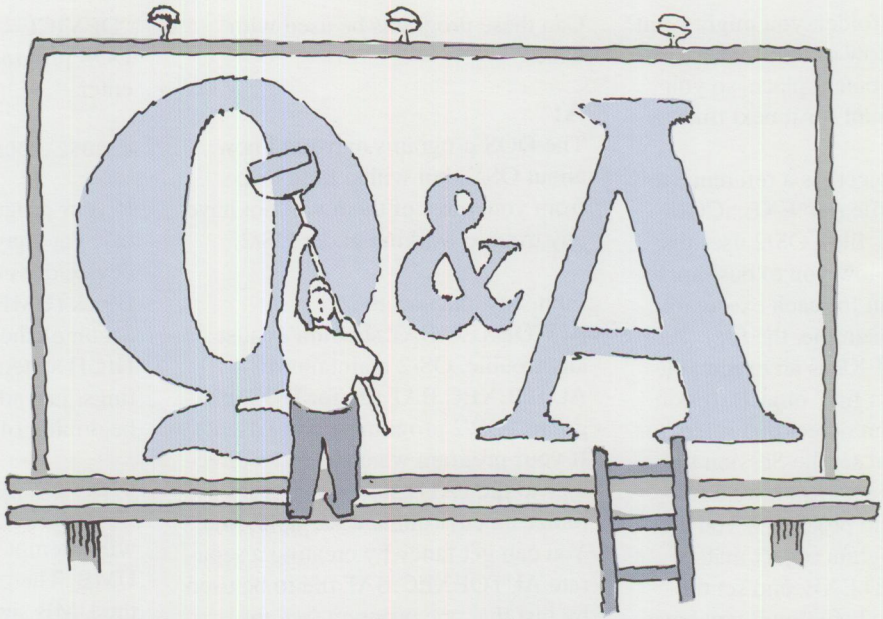
This was not what I expected. With all of the hype and Microsoft marketing muscle, I expected far more votes for NT. I expect that this is the first time that the majority of these people have seen both NT and OS/2 2.1 live and up close, and this may possibly be the reaction of more such average users when they get a chance to see these operating systems for themselves.

I only wish that Bill Gates could have been there to see it with his own eyes!

David Matocha *is a semiconductor process/automation engineer for Texas Instruments, and has been working on the automation of wafer fab equipment and processes for several years. Before that, he worked to develop manufacturing processes for microlithography and the plasma etching of semiconductors. David joined TI in 1983. He can be reached via Internet at david.matocha@yob.sccsi.com.*

OS/2 Questions and Answers

Doug Azzarito
IBM Corporation
Boca Raton, Florida



Q:
Shadows, templates, folders....HELP! I'm new to OS/2 and the concept of an object-oriented operating system. All these different object types have me confused. Can you straighten me out?

A:
Object-oriented systems can be confusing, but if you relax and let common sense guide you, your confusion will quickly fade. I mention common sense because the object types in OS/2 are supposed to look and act like real-world objects, things with which we are already familiar. Let's look at some of them.

A "folder" object is a subdirectory on a disk. They may seem to have magical powers, but they're just subdirectories. (The objects inside OS/2 folders may be quite different than the files you may have put in your DOS subdirectories, but that's another story.) When you create a folder on your desktop (by dropping a folder template on the desktop), you are just issuing the command: MD C:\DESKTOP\FOLDER. Dropping the folder on the shredder is the same as deleting all the files inside the subdirectory and issuing: RD C:\DESKTOP\FOLDER. Although the commands end up in the same place, using the Workplace Shell to manipulate folders is a lot easier than the "old-fashioned" methods of directory manipulation. Moving, copying and deleting entire directory trees can be done with a single drag-and-drop.

A "template" object is like a rubber stamp. Rather than writing PAID on all your bills, the rubber stamp does it for you — it can make as many copies of the word PAID as you care to stamp. Similarly, the OS/2 template can make as many copies of something as you want. The added benefit of templates is that you can make a template for just about any object.

As an example, let's say you work with a spreadsheet package to do monthly reports. Each month you create a spreadsheet with the same format, headings, and macros. Rather than repeat that work every month, create a blank monthly spreadsheet, and save it in the templates folder (templates can be saved anywhere, but you'll find them easily if they're in the templates folder). Now, open the settings for the object, and check the "template" box (on the General page). Just by setting this check-box, you have turned the object into a template.

When you drag-and-drop a template, OS/2 will make a copy of the object (in this case, your blank spreadsheet) in the folder where you drop it. If you want to make changes to your blank spreadsheet, just clear the "template" checkmark, edit the spreadsheet, and set the "template" checkmark again.

OS/2 comes with templates for common objects, and some OS/2 applications will add others. Try using them, and adding your own, to see how easy templates are to use.

A "shadow" is a way to break the natural law that says you can't be in more than one place at the same time. Shadows let you group together objects without having to physically move the object. For example, you can create a work-area folder that contains programs, data files and other folders. Rather than moving all these objects into the work area, you can create shadows of them all, and place the shadows in the work area. This gives you quick access to all the objects in one place; and when you are done with the work area, you can toss it in the shredder. Deleting a shadow does not delete the original object. If you are always digging through the Drives object in search

of a particular folder, you might want to make a shadow of that folder and put it in a convenient place, so you don't have to hunt for it next time.

A "program object" is a reference to an executable file (an .EXE, .COM, .CMD, or .BAT file). OS/2 uses these references to allow you to customize the environment for each executable program. For example, the file C:\OS2\CMD.EXE is an executable file (a "program file" object). If you create a program object that refers to CMD.EXE, and set the Session to "OS/2 full-screen," you have a full-screen command prompt. If you create another program object that references CMD.EXE, and set the Session to "OS/2 window," you have an OS/2 windowed prompt.

Changing the settings in one of these program objects (the name, the icon, or other settings) does not affect the other, nor does it affect C:\OS2\CMD.EXE. Don't confuse a program object with a shadow — they have similarities, but they are quite different. A program object is used only to reference an executable file, whereas shadows can reference anything. A program object allows you to customize and modify environment settings without changing the original, while changes made to shadow settings *do* change the original object. If you delete a program reference, the original executable file is not deleted (which is also true of shadows).

With a little experimentation, you'll learn all about the power of objects under OS/2, and you might become convinced to give up the command line forever!

Q:

Some DOS programs want to modify CONFIG.SYS and AUTOEXEC.BAT when they install. Can these programs be used with OS/2?

A:

The DOS programs may not know about OS/2, but with a little help from you, most of them will not have any trouble working under OS/2.

First, any changes to AUTOEXEC.BAT shouldn't cause any trouble. OS/2 maintains an AUTOEXEC.BAT file for DOS programs (OS/2 programs do not use it). If your program wants to add a directory to the PATH statement, or initialize an environment variable, fine. You can get fancy by creating a separate AUTOEXEC.BAT file to be used by just that one program (see the DOS_AUTOEXEC setting in the DOS Settings).

Changes to CONFIG.SYS need a little more attention. Some programs may want to modify a setting in CONFIG.SYS, and if they look through the OS/2 CONFIG.SYS, they'll probably find what they want and make the change. That won't bother OS/2, as long as the DOS program makes the change correctly. If the DOS program needs to install a device driver, you will have to decide whether the driver can be loaded for *all* DOS sessions, or just a specific program. Any DEVICE= statement in CONFIG.SYS that specifies a DOS device will be loaded for every DOS session. That may waste memory, and sometimes will cause problems.

If the device driver is needed by only a single program, it makes more sense to put it in the DOS Device setting for just that program. Create a program object for your DOS program, and open the DOS Settings. In the DOS_DEVICE setting, enter the DEVICE statement as specified by the program, but leave off the word "DEVICE=." For example, if your DOS program requires ANSI.SYS, enter:

```
C:\OS2\MDOS\ANSI.SYS
```

If your program requires more memory, you may be able to load the device driver into an Upper Memory Block (UMB). In DOS, this was accomplished with the DEVICE-HIGH statement. In the DOS Settings, just add SIZE=0 to the beginning of the line. For example:

```
SIZE=0 C:\OS2\MDOS\ANSI.SYS
```

will attempt to load ANSI.SYS into a UMB. The "size" parameter specifies the UMB size required for this driver. Most of the time you won't know, so leave it at 0, and OS/2 will determine the size. If UMBs aren't available, OS/2 will load into conventional memory. For UMBs to operate, the DOS Setting DOS_UMB must be set to ON, and the DOS session must have enough XMS memory to fill the UMBs with RAM.

Got a question?

If you have questions about OS/2 2.1, or have a technical tip you would like to share with others, send me a note. I can be reached at:

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Internet: azzarito@cse.fau.edu
FIDO: 1:369/85

Doug Azzarito *is president of Technology Consultants of the Palm Beaches, Inc., a microcomputer consulting firm. He has worked on contract to IBM on OS/2 development projects since 1986. Doug is also co-author of RBBS-PC, the industry-standard bulletin board software for personal computers. He received a BS in computer science from the University of Florida in 1982.*

Workplace OSs: Door to the Future

Paul Giangarra
IBM Corporation
Boca Raton, Florida

Workplace Operating Systems constitute the next generation of operating system platforms for personal computers. This article presents a high-level view of the architecture of Workplace OSs, and explains how Workplace OSs will enable applications to run across multiple system platforms. This article originally appeared in Issue 1 of The Developer Connection News.

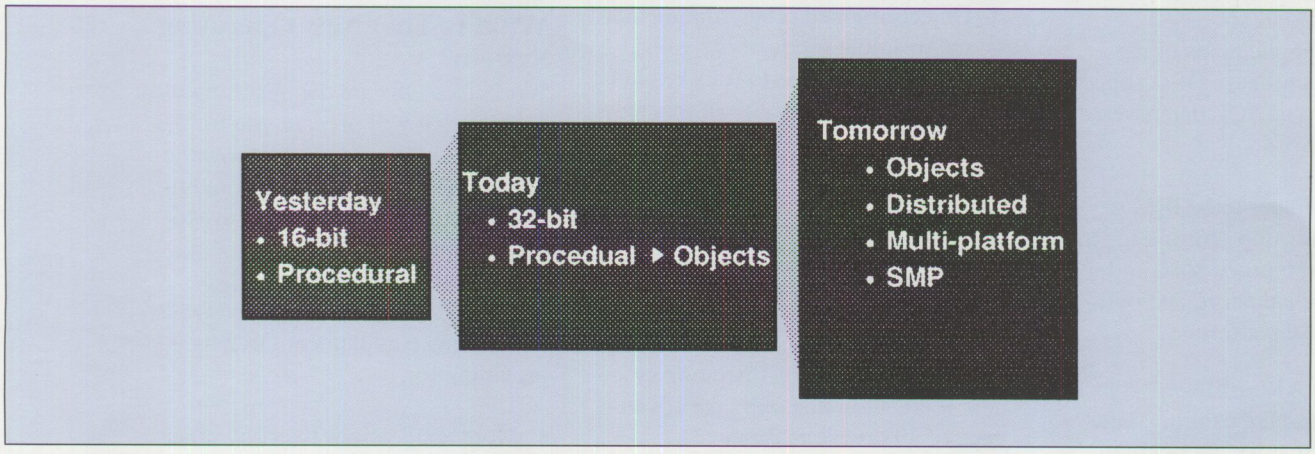
Workplace Operating Systems (Workplace OSs) will change the way you think about your computer. They're a whole new concept in operating system architecture. By unifying the worlds of multiple operating systems, and providing a new base for common services, scalable and flexible systems are born. Workplace OSs protect your current investment, as well as bring you into the future. A key feature of Workplace OSs is their support for 32-bit applications.

With the roll-out of OS/2 2.1, we have provided you with a true 32-bit operating system that extends the features of OS/2 2.0 with significant new features. OS/2 2. truly takes advantage of the capabilities of the increased power of the new generations of Intel-based processors, including Pentium.

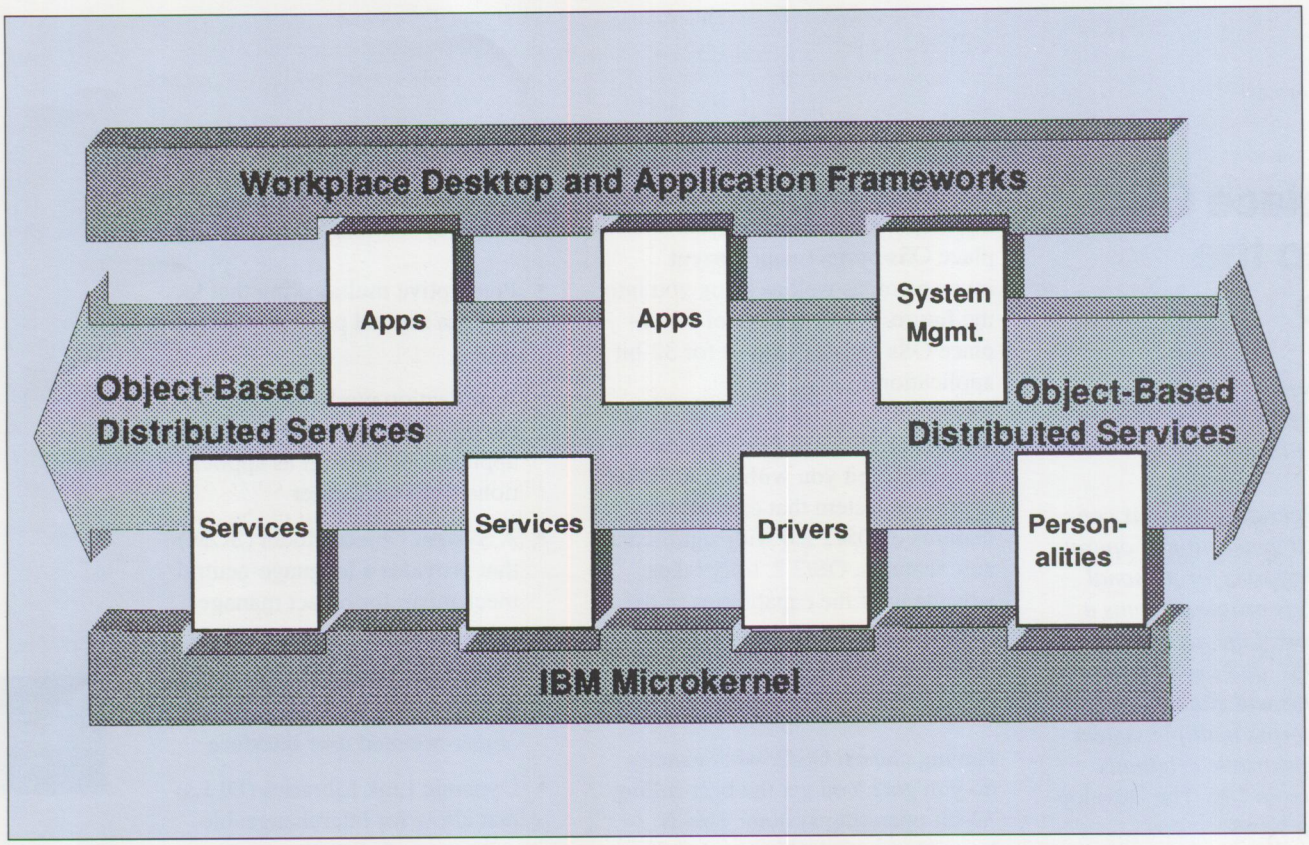
Having chosen OS/2, what exactly do you get? You get the best-selling 32-bit operating system. This is because your operating system is designed to handle the increased requirement of complex programs, such as multitasking and object-oriented programming (OOP). You are also working in a protected environment, so if one application fails, the system continues to function.

Internally, OS/2 provides support for even more, including the following:

- Preemptive multitasking that lets you run several programs at one time
- A protection model that isolates the operating system from errant applications, as well as applications from each other
- A System Object Model (SOM) that provides a language-neutral mechanism for object management services
- A Workplace Shell, implemented on SOM, that provides a powerful, object-oriented user interface
- Dynamic Link Libraries (DLLs) that allow for interchangeable software components
- A 32-bit presentation driver model that lets you add and install such items as printers and displays, as needed, and without requiring a complete reinstallation.



Door to the Future



The Workplace Look

- Installable file systems that allow the addition of new types of file systems, such as CD-ROMs.
- Multimedia audio and video players.

In addition, OS/2 can support the enterprise-wide, LAN-based client/server applications of the future. This is because OS/2 supports such functions as SQL databases, CICS, and REXX.

OS/2 2.1 continues to be IBM's mainstream desktop offering for Intel x386 and 80x86 processors, and will continue to be enhanced and optimized for those platforms.

What Lies Ahead?

What lies ahead are exciting, new technologies that we are ready to exploit. Some of these technologies include:

- New hardware architecture and platforms that will provide a significant increase in computing power
- Object-oriented programming that will result in productivity gains, making it possible to fully exploit the power and features of this new hardware
- New devices, such as speech, wireless, and enhanced video, that will provide exciting new functions

So how do we get to this future? We are developing a new operating system foundation that will take advantage of all these emerging technologies. It will include features such as a higher security level and the use of multiple processors (MPs).

This operating system foundation will let you move forward to the future, while preserving your current investment.

What Is That New Operating System?

Workplace OSs are the operating systems that will prepare you for the future. Workplace OSs combine the best, most elegant features of multiple operating with the flexibility to run on unlimited platforms.

Workplace OSs do not replace OS/2; rather, they complement OS/2 by providing for:

- More applications than any other operating system

- Increased and varied hardware support
- Open system architecture, providing for increased potential in a scalable environment
- Increased quality and flexibility

The products that make up Workplace OSs are:

- IBM Microkernel
- Common (cross-personality) services
- Multiple personalities

IBM Microkernel

The IBM Microkernel is a product that provides the base mechanisms required for building operating systems. It is not tied to any operating system-specific functions.

The Microkernel is pure, simple, and minimal. It isolates all the critical, machine-dependent services from the operating environments outside of it.

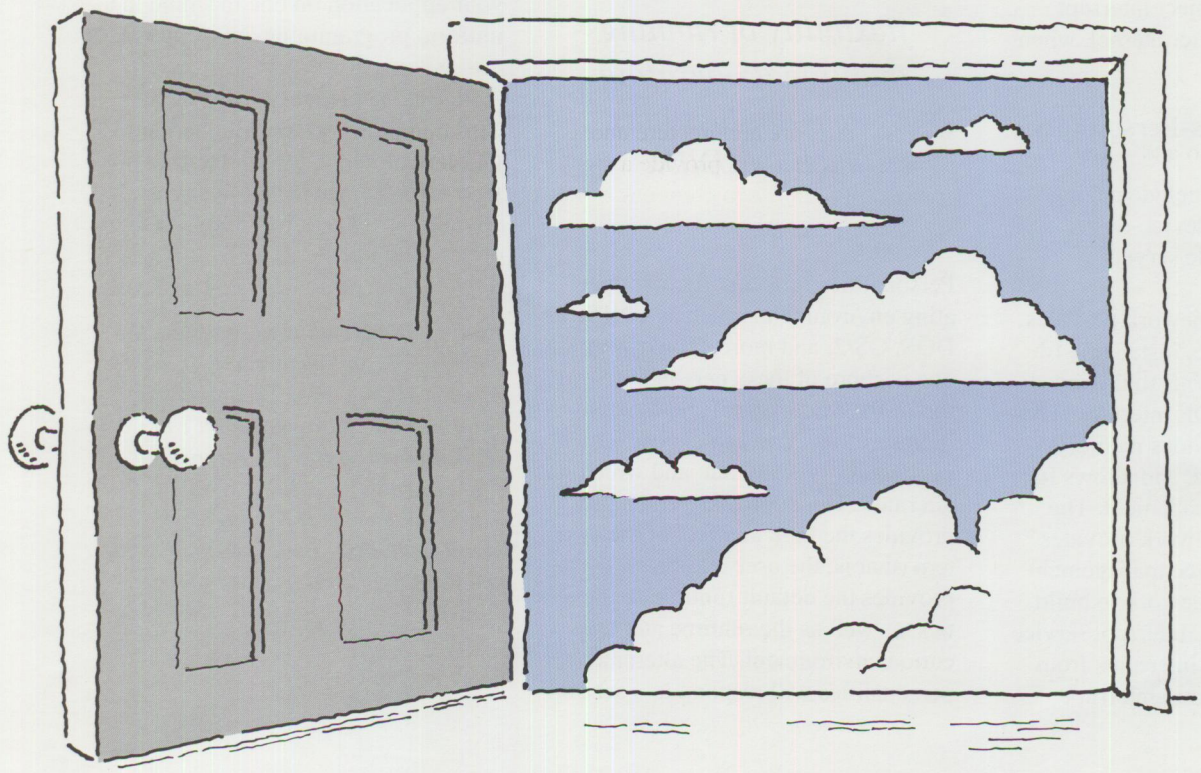
All of the operating environment policies are set by the operating environment personality. Common services are extended to the Microkernel, and are available to each other as well as other personalities.

The Microkernel is based on Carnegie Mellon University's (CMU's) Mach technology, which provides for:

- Task management (tasks, threads, and dispatching)
- Interprocess communications (IPC)
- Memory management
- Interrupt management

The Microkernel does not enforce policy; rather, it executes whatever policy is set externally. The Microkernel embraces future technology by providing for the current 32-bit technology, but allowing for 64-bit extensibility. It provides for flexibility, integrity, and scalability. The design of the Microkernel encourages modular client/server design, which reduces complexity.

Each point of control within the Microkernel is a thread having access to all of the elements in the task that contains it. A task defines the virtual address space of its threads. It holds the system resources for the threads contained within it. A task does not have a life of its own; it is governed by the threads it contains. Only threads can execute instructions. All threads contained in a specific task share all of that task's resources. Tasks exist as separate entities; for example, they cannot share any resources without taking explicit action. Tasks resemble UNIX processes and, in fact, are the mechanisms by which UNIX processes are created by the UNIX personality.



Each task contains an associated memory map that is also known as an address space. As with most virtual memory systems, a mechanism must exist to use physical memory as a cache for the virtual addresses of tasks. Because this is a generic Microkernel, the operating system personalities must participate in this mechanism. The Microkernel's memory management provides the mechanisms of memory objects and functions to manipulate all this.

Mach IPC (ports) manage client/server communication. The requesting thread (client) accesses services by sending messages to the owning task (servers). These messages are sent over communication channels called ports.

Mach provides first-level interrupt management services that rely on device support to provide specific second-level interrupt handlers. The Microkernel sees the tasks and threads as external to itself. The device driver can inject interrupt handlers into the Microkernel, where necessary.

Common (Cross-Personality) Services

Common services include paging services, security, device-driver frameworks, and file servers.

The file-server framework provides support for multiple, installable file systems, and conforms to the industry-standard VNODE interface. The file server also provides memory-mapped file support, and allows for logical volume management. The device-driver framework provides for hardware resource management and a common framework to build base device drivers. Interrupt service routines (ISRs) get interrupts from first-level Microkernel interrupt management, and reflect interrupts to the device drivers that are executing in user space. The default pager handles page faults that are reflected by the Microkernel.

Multiple Personalities

External to the Microkernel and common services are personalities that provide the specific services for the operating systems. Personalities are actually application loaders and launchers. They let you run operating system-specific applications on multiple operating systems. Personality-specific services work with the personality server and personality-neutral services to map application requests to the correct services with the proper semantics.

Adding alternate personalities will grant you the enhanced flexibility of running additional operating system applications, such as UNIX.

Personalities reflect particular operating environments, such as UNIX, DOS, OS/2, and more. You can run one or more of these personalities on top of the Microkernel and the common services. You can choose which personality is dominant, and which is alternate. The dominant personality provides the look and feel of the system (that is, the user interface). It provides the default runtime semantics, as well as the runtime and execution environment. The alternate personalities will respond to a set of requests from the dominant personality. For example, the UNIX dominant personality looks to the other personalities to recognize, load, and launch anything other then an UNIX application. However, the UNIX personality will handle all UNIX applications itself.

So, whatever your dominant personality is, your operating systems can run just like your operating system does today. Adding alternate personalities will grant you the enhanced flexibility of running additional operating system applications, such as UNIX.

What Does All This Mean to Me?

What this means to you, as a developer, is that by using multiple personalities, you are going to have a flexible environment in which you can run not just one, but multiple applications across system platforms. It also means that you will be able to develop and test different flavors of your application on one machine in a uniform programming environment.

And, each personality will share a common look and feel — the Workplace Shell look. Workplace OSs are your key to a whole new level of computing. This is why they are your door to the future.

Paul Giangarra *has been with IBM since 1977, and is currently a member of IBM's Senior Technical Staff. Paul has had many different roles at IBM, including Chief Designer for OS/2 during OS/2 1.2, 1.3, and 2.0. He is current Lead Architect for Workplace OSs. Paul is a member of the Personal Software Architecture Board.*

Microkernel Technology

Allen G. Taylor
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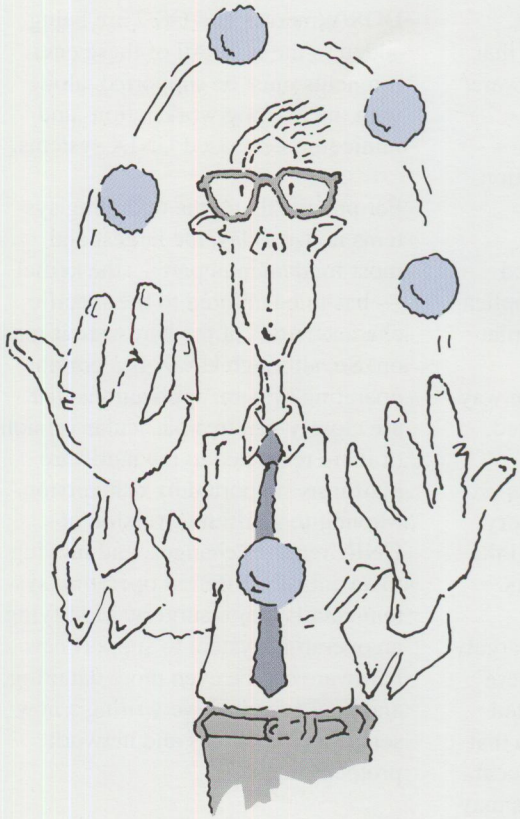
This article and the following article by Freeman Rawson are both about microcomputer technology. They are complementary in that this article focuses on the concept and the advantages of microcomputer technology, whereas the following article discusses the technical aspects of IBM's implementation of microcomputer technology.

This article was commissioned and sponsored by IBM Personal Software for publication in UNIX World Direct.



As manager of support for your company's UNIX-based minicomputers and engineering workstations, you have barely been able to provide adequate service to your customer departments. Your staff is overworked, and you are over budget due to unscheduled overtime. Your overall effectiveness is slipping, because there is neither time nor room in the budget for the training needed to maintain and improve your staff's skills. Now you are informed that, due to a consolidation, you must assume responsibility for maintaining personal computers in three new departments, one running Windows 3.1, another running OS/2, and the third running UNIX. None of your people are trained on any of those environments. What do you do now?

If the above scenario seems distressingly familiar, you are not alone. The outlook for the immediate future is that situations like this will become more common rather than less. As more and more hardware platforms and operating systems carve out niches in the marketplace, support is becoming a nightmare for software vendors and users alike.

Intel-based personal computers have been contending for years with Macintosh models based on Motorola's 680X0 family of processors. Now a bewildering variety of RISC machines is joining the fray. Operating system vendors must decide which ones to support, and in what order. Delays in operating system support cause even greater delays in the availability of applications.

With today's short life cycle for application software, some platforms may never host the number and variety of applications they need in order to survive. Application software vendors must spend large amounts of time and money to configure their products for multiple operating systems and hardware platforms.

User organizations don't have it any easier. Their IS departments must support multiple hardware platforms and operating systems to provide all the applications their users need. Such duplication of effort tends to inflate costs and decrease the quality of service delivered on each platform.

Despite industry efforts at standardization, the number of different hardware platforms and operating systems is growing rather than declining. Even the largest companies in the industry are coming to the conclusion that they cannot continue to provide ever-increasing support in

an era of eroding profit margins. They are looking for new ideas that promise to replace the old hardware/operating system/application paradigm with something new — something that reduces duplication of effort in a major way.

Many of the problems associated with developing and running applications across multiple hardware platforms and multiple operating systems are a direct result of the way operating systems are constructed. Operating systems were first designed in an era when a single processor, connected to local memory and local on-line storage, did all the computing for one or more users.

Today that paradigm has been largely replaced by an environment where multiple processors are connected together, and are accessing data that is located at remote as well as local sites. Those multiple processors may be of different types, and may be running different operating systems. The classical operating system model does not do a good job of handling the new arrangement.

The Classical Model

Traditionally, a computing system has been composed of three functional layers: the applications software, the operating system, and the hardware. The application program follows an algorithm to perform a function desired by the user. Applications frequently call upon the operating system to give access to system resources. It also permits applications to run concurrently on the machine, cooperate as desired, and make smooth transitions from one program to another.

Proliferation of operating system versions has been a nagging problem in the UNIX community for years, and personal computers running DOS/Windows and OS/2 are being added to the mix. All of these environments must be supported, along with the existing workstation- and minicomputer-based UNIX systems.

For practically all the operating systems in use today, the largest and most fundamental part — the kernel — has to be tailored to the specific characteristics of the hardware it runs on. So, although UNIX is a portable operating system, applications that are closely tied to a particular version of it are restricted to the hardware platforms supported by that version. Moving to a different version of UNIX requires changes, and moving to an entirely different operating system entails major surgery. Modifying an operating system to support new hardware can be even more daunting, and may even involve writing a new set of device drivers and network protocol stacks.

Application developers wanting to make their products available on multiple hardware platforms are faced with the time-consuming, redundant, and downright boring prospect of writing, and then maintaining (in perpetuity), a version of their application for each operating system variant.

In all likelihood, code containing calls to the operating system will have to be completely redone. After the changes are made, exhaustive compatibility testing must be conducted to assure that everything works the same way on the new platform as it did on the old one. People who are very experienced developers on the old platform will find themselves at the bottom of the learning curve on the new one.

User organizations, particularly those that have more than one operating system, have problems too. They must understand and support multiple file systems, multiple device-driver models, multiple graphics architectures, and possibly multiple networking models. In addition, data stored on one kind of system may be difficult or impossible to access from another.

The Microkernel Concept

Because of the growing problems with traditional system architecture, computer scientists at several universities, both in the United States and abroad, have developed a new way of thinking about operating systems, called the *microkernel architecture*.

There are two key ideas in microkernel architecture. The first is that all but the absolute minimum of code be written such that it does not depend on the underlying hardware. The second key idea is that low-level functions common to all operating systems be strictly separated from those high-level attributes that give an operating system its characteristic look and feel. Both of these goals require that the system be highly modular. Adhering strictly to them brings substantial benefits.

When porting from one hardware platform to another, only the small, machine-dependent portion of the microkernel is affected.

- Device-driver code can be structured to depend on the processor type, or how devices are attached to the machine.
- Due to its modularity, the microkernel is simpler and easier to understand than a standard operating system.
- Application programming is the same, regardless of processor, and regardless of whether the machine has one or more CPUs.

Since most of the system is machine-independent, developers need to ascend the learning curve only on the first platform. On subsequent machines, nearly everything is exactly the same.

Concept to Implementation

Acutely aware of the problems associated with maintaining multiple operating systems on multiple hardware platforms, IBM has developed a robust implementation of microkernel technology as a comprehensive solution. The IBM microkernel product incorporates technology from the Mach 3.0 project at Carnegie Mellon University (CMU), as well as selected technology developed by the Open Software Foundation Research Institute. IBM's Workplace OS family is built using the microkernel product and other products such as the DOS/Windows, OS/2, and UNIX operating systems.

When IBM decided to break with the past and move away from the traditional model, it had several goals in mind. First, it wanted to develop an operating system that was substantially machine-independent, so that moving from one hardware platform to another would be easy. Second, it wanted the ability to run, without modification, applications that had originally been written for existing operating systems, such as PC-DOS, OS/2, and UNIX. Third, IBM wanted to be able to simultaneously run those applications.

The Workplace OS family of products is highly modular, as shown in Figure 1. The color coding in the figure indicates that only a small portion of the code in the microkernel product of the Workplace OS family is machine-dependent. This code has been isolated from the rest of the microkernel, which is not machine-dependent. Most microkernel modules are not only independent of any particular CPU, they are also independent of any devices attached to the systems. The device-support module, containing device drivers, naturally depends on the devices supported. However, like the rest of the machine-independent modules, it does not care what kind of processor the machine has.

None of the code on the microkernel product is specific to any one operating system. Instead, it supports all of them.

As shown in Figure 1, Workplace OS will initially support Intel 386, 486, and Pentium processors, as well as the Motorola PowerPC. Other processors can be added relatively quickly by writing the small machine-dependent portion of the microkernel represented by the thin dark bar. The core of the microkernel has five parts:

- Interprocess Communication (IPC)
- Virtual Memory
- Tasks and Threads
- Host and Processor Sets
- I/O Support and Interrupts

A portion of each one of these parts is machine-dependent, but most is machine-independent. In addition to the microkernel core, the IBM microkernel product will also include a set of *personality-neutral services*, including a program loader, a name service, the default pager, and device support. Both IBM and almost all third-party developers may add additional personality-neutral services.

None of the code on the microkernel product, which includes the microkernel core and the personality-neutral services, is specific to any one operating system. Instead, it supports all of them. The part of the system that does have the unique look-and-feel of a specific operating system is called a *personality*.

Several personalities can be added relatively easily, since the code that is common to all operating systems is already done. Only those aspects that differ from one operating system to another are included in the personality.

When two or more personalities are present on a system, one of them serves as the dominant personality, and the others as alternate personalities. The dominant personality has some housekeeping tasks in addition to those that specifically relate to the operating system it is emulating. The applications run on top of the personalities.

In contrast to a classical operating system, the Workplace OS family can be viewed as a set of servers that can be configured in a variety of ways. The microkernel at its core is a message-passing nucleus that operates at the hardware's most privileged level.

The Workplace OS confers specific advantage to application developers, users, IS managers, and hardware manufacturers, in addition to those general advantages listed above for the microkernel architecture.

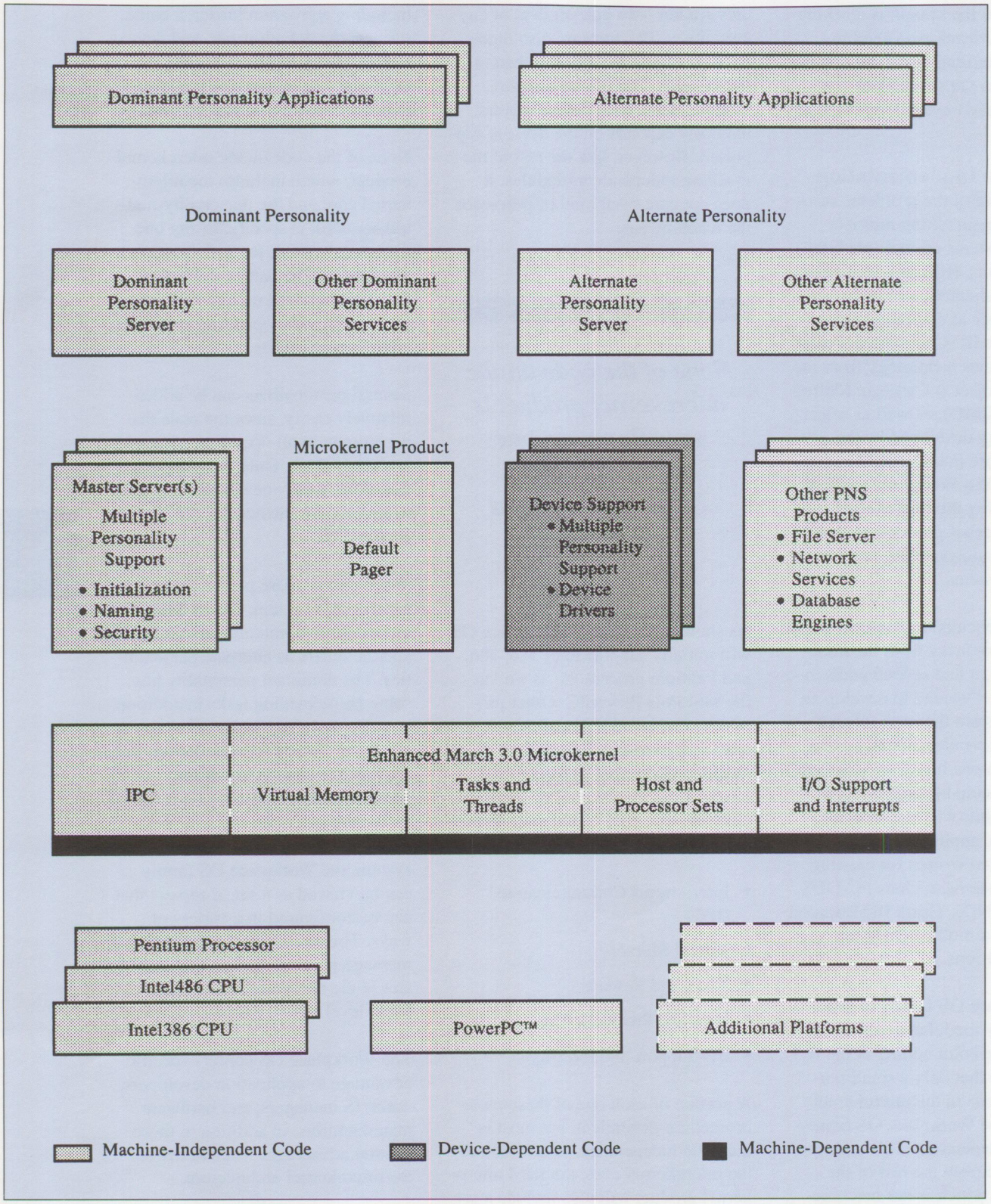


Figure 1. Microkernel Architecture

Advantages for Application Developers

- Many traditional operating system functions have been moved out to server programs that run on top of the microkernel as "applications." This reduces operating system complexity, making it more modular, more understandable, and more scalable.
- You can write all of your applications using your favorite operating system personality. Users with microkernel systems will be able to run them regardless of what their favorite personality might be.
- Since personalities can be written quickly, lower-volume development environments (such as UNIX) will be available just as soon as the higher-volume environments (DOS). This allows you to get your applications to market quicker.
- The Workplace OS family's open architecture means that, if you want to replace its standard file server, networking architecture, device-driver model, or interrupt services with your own, you can do so.
- The microkernel is intrinsically multi-threaded, and thus it is able to take advantage of symmetric multiprocessor (SMP) configurations.
- The specialized code needed to support multiprocessing is restricted to the small, hardware-dependent portion of the microkernel.
- The Workplace OS family was designed with massively parallel machines in mind, so it is scalable from palmtops to supercomputers.
- Third-party development of personalities and personality-neutral services is encouraged and facilitated by the open architecture.

Advantages to Users

- Workplace OS is able to simultaneously run applications that were originally written to execute on different operating systems.
- Since new systems can come to market quicker, you can start using them sooner than would otherwise be possible.
- Device drivers will become available on the lower-volume platforms (e.g., UNIX and OS/2) just as soon as the higher-volume platform (DOS).

Advantages to IS Managers

- There is less hardware and system software to support, since you can offer several operating system environments on a single computer, concurrently and working together.
- You can run any operating system personality on any hardware platform.
- Workplace OS will support the Open Software Foundation's Distributed Computing Environment (DCE) standard.
- The architecture gives better support to distributed systems.

Advantages to Hardware Manufacturers

- An IPC messaging architecture is ideal for use on intelligent adapters and process controllers.
- The amount of code needed to support a new processor is small.

Advantage to Entrepreneurs

- You can now enter the operating-system business by writing a small personality, instead of having to put man-years into developing an entire system. Better yet, your new operating system personality will immediately run on all microkernel-equipped machines.

Promising Technology

Microkernel architecture is the most promising technology available to get applications running on new hardware sooner, and to reduce the maintenance burden brought about by the introduction of that new hardware. Most activity in the field is still at the research stage, although Chorus Systems of Beaverton, Oregon has a microkernel-based product on the market. Chorus' product comes from a European development team, and is unrelated to IBM's work.

Comparing the products developed by IBM and Chorus, only IBM has capitalized on the microkernel's ability to simultaneously support multiple personalities. The IBM Workplace OS family may also have the best chance of being accepted as a standard in the marketplace.

The operating system engine that has propelled computing for the last three decades is finally running out of steam. It is time to climb aboard a new train. Microkernel technology has the power and flexibility to pull us through the next three decades, regardless of changes in underlying processor architecture, or in our ideas of what the best user interface looks like.

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IBM's Microkernel Technology

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This article was derived from the brochure titled IBM Microkernel Technology *created by Freeman Rawson and published in May 1993, and is reprinted with permission from Issue Three, 1993 of* Innovations, *the publication for IBM Boca Raton technical professionals. The article discusses the technical aspects of IBM's implementation of microcomputer technology.*

The IBM microkernel is a modular, portable software kernel that promises powerful open systems advantages for system developers and end users. This article provides an overview of the technology and the architecture, and discusses the benefits the microkernel delivers, not only to application developers but also to end users.

Dramatic advances in computing architecture, hardware designs, and technology have spawned an amazing variety of programming methods, user interfaces, development tools, communication techniques, and application software. Delivering previously unheard-of advantages to end users in performance, service level, and system utility, the overwhelming diversity of system offerings has also heralded the cry for "open systems" and "standards."

IBM, long a leader in creating new systems delivering a broad range of application capabilities to a wide range of users, is again committed to developing the new, open technologies needed for the next computing decade.

IBM is developing the next generation of highly portable systems software, and related applications, around a microkernel. The microkernel provides a new way of structuring systems software to reduce its complexity, and to increase its portability. It presents the potential for building a single, truly open, computing environment — using a microkernel "core" product executing multiple diverse operating systems as "applications" on a single hardware platform.

IBM is developing the next generation of highly portable systems software, and related applications, around a microkernel.

The promise of microkernel-based system software lies in providing better ways to cope with the increasing complexity of system designs; the potential for system software to be "in tune" with the startling leaps forward in processor hardware; the possibility of sharing low-level programming between operating system environments; and ultimately, the ability of the end user to select the best available application — independent of the available processor.

Systems built using microkernel technology will deliver a new standard for modular, portable operating systems development platforms. Rather than creating a single, monolithic system, developers write a set of servers that can be configured in a variety of ways to provide the target operating system.

The microkernel is a small, message-passing nucleus of systems software running in the most privileged state of the computer, supporting the rest of the operating system as a set of server applications. IBM's microkernel product encompasses both the microkernel itself and a set of personality-neutral services that provide device functions and selected other functions for any operating environment. Interest in microkernels has grown as system developers have reacted to the complexity of current operating system implementations, and as the research community has demonstrated the feasibility of the microkernel concept.

The Mach microkernel technology created at Carnegie Mellon University serves as the basis for IBM's microkernel work. IBM's microkernel also incorporates selected technology developed by the Open Software Foundation Research Institute. On the Mach base, IBM is developing additional microkernel functions; creating a set of personality-neutral services; implementing low-end environments; integrating multiple operating system personalities on a single computer; and enabling new ways of delivering DOS execution environments.

By virtue of their size and their ability to support standard programming services and features as application programs, microkernels themselves are simpler than standard operating systems. With a microkernel, operating system function is broken down into modular pieces that may be configured in a variety of ways, permitting larger systems to be built by adding pieces to smaller ones. For example, each personality-neutral service is logically separate, and may be configured in a wide variety of ways.

Microkernels also make it easier to support multiprocessors by creating a standard programming environment that can use multiple processors if they are present, but does not require them. The specialized code for multiprocessors is restricted to the microkernel itself. Moreover, networks of communicating microkernels can be used to provide operating-system support for the emerging class of massively parallel machines. Since they are small, and have relatively little kernel-level code to execute, microkernels provide a convenient way to support the real-time features needed for multimedia, device control, and high-speed communications.

Finally, well-structured microkernels provide an insulating layer for hardware differences that are not masked by the use of higher-level programming languages. Thus, they make porting code easier, and increase code re-use.

By starting with Mach, IBM is able to make use of the active research and advanced development being done on the Mach base. Current Mach research and development activities include ongoing research work at Carnegie Mellon, as well as Mach-related work at the University of Utah, the University of Arizona, and Cornell University. The Open Software Foundation Research Institute, building on its previous work and on research done at Carnegie Mellon, has created a version of Mach that supports massively parallel supercomputers. There is also work under way at the Center for High-Performance Computing of Worcester Polytechnic Institute on real-time extensions and file-system servers for a Mach environment.

Microkernel Technology Overview

The functions performed by the microkernel itself are limited, to reduce its size and to maximize the amount of code that runs as an application program. The microkernel includes only those functions that are required to define a set of abstract processing environments for application programs, and to permit applications to work together to deliver services and to act as clients and servers. As a result, the microkernel provides only five different types of services:

- Virtual memory management
- Tasks and threads
- Interprocess communications (IPC)
- I/O support and interrupt management
- Host and processor set services

Other operating system functions such as file systems, device support, and traditional programming interfaces are placed into one or more personality-neutral services, or into an operating system personality. These programs run as applications on the microkernel. Figure 1 (on page 74, in the article by Allen Taylor) illustrates this structure by showing how IBM is using the microkernel and personality-neutral services to run multiple operating-system personalities on a variety of hardware platforms.

Architecture of the Microkernel

The virtual memory component of the microkernel supports large, paged, sparse address spaces that are composed of memory objects. Each memory object is managed by a pager, a task outside the kernel that provides the backing storage for the pages of the memory object. Address spaces are managed by mapping or allocating memory objects within them. The microkernel manages memory protection and sharing on a memory-object basis in an abstract way, independent of any particular processor address translation hardware.

In particular, the microkernel makes heavy use of copy-on-write to permit programs to share memory objects without copying large numbers of pages when a new address space accesses the memory object. New copies of the pages are created only when a program in one of the address spaces updates them.

When the microkernel takes a page fault in a memory object and does not have the page in memory, or when it has to remove pages from memory due to the requirements of other programs executing on the machine, it notifies the pager for the memory object in which the fault occurs, using the IPC mechanism. It is then up to the pager, an application server, to determine how to provide or store the data. This permits the system to define different semantics for memory objects, based on the needs of the programs that use them. The default pager shown in Figure 1 provides a pager for memory objects that do not require anything other than the usual semantics of virtual memory.

The microkernel manages the execution environments for programs by providing multiple tasks and threads. Each task has its own address space, or map. It assigns memory objects that the task has mapped to ranges of addresses within the address space. The task is also the unit of resource allocation, and protection with tasks being assigned capabilities and

access rights to the IPC facilities of the system.

In order to support parallel execution by a program within a single address space, the microkernel separates the execution environment from the actual running of streams of instructions. The streams of computation including the processor resources needed to support them are called *threads*. Thus, a program can be loaded into a task and can be executed in several different places in the code at the same time on a multiprocessor or parallel machine. This can result in better application performance.

The IPC system provides the basic mechanism that allows threads running in different tasks to communicate with each other. The IPC system supports the reliable delivery of messages on ports. Ports are protected channels between tasks. Each task that uses a port is assigned a set of rights to that port. These rights may be different for different tasks. Only one task can receive on any port, although any thread within the task may execute the receive operation. One or more tasks may hold rights to send to a port. The kernel permits tasks to use the IPC system to transfer port rights among themselves. It also provides a high-performance way of passing large data areas in messages. Rather than copying the data, the message contains a pointer to it; this is called a *pointer to out-of-line data*. When the kernel transfers the message from the sender to the receiver, it makes the memory being passed appear in the receiver's address space, and optionally disappear from the sender's address space. The microkernel itself is structured internally as a task with threads, and most of the system services are implemented as IPCs to the kernel rather than as direct system calls.

In order to support I/O and device access, the microkernel provides access to I/O resources such as memory-mapped devices, I/O ports, and direct memory access (DMA) channels, as well as the ability to reflect interrupts to device drivers executing in user space. The microkernel has services that let privileged programs acquire ownership of devices; these programs are typically personality-neutral services, such as device-driver servers running as applications, as shown in Figure 1.

All of the support needed for multiprocessors is concentrated into the relatively small and simple microkernel.

Since the microkernel must field all interrupts (because interrupts are typically delivered into the privileged state of the computer, and in order to maintain the integrity of the system), it has logic that determines whether it should process the interrupt or reflect it to a server. If the interrupt is to be reflected to an application, it must have registered with the microkernel and contain code that waits for the kernel to reflect the interrupt. When the interrupt is reflected, a thread in the application begins running to process the interrupt.

The host and processor set features provide two related sets of functions that are needed if application programs are to provide most operating system services. The features on the host return information about the processor complex running the system, and provide certain system management functions such as time, date, and system stop and restart. The processor set features are used on multiprocessor machines to group processors in classes. These classes permit a parallel application to execute multiple threads simultaneously on different processors in the machine, so that true parallel execution occurs.

Figure 1 also shows that the microkernel carefully splits its implementation into code that is completely portable from machine to machine, and code that is dependent on the particular machine on which it is executing. It also segregates the code that depends on devices into the device drivers; however, the device-driver code, while device-dependent, is not necessarily dependent on the processor architecture.

Using multiple threads per task, the microkernel provides an application environment that permits the use of multiprocessors without requiring that any particular machine be a multiprocessor; on uniprocessors, different threads simply run at different times. All of the support needed for multiprocessors is concentrated into the relatively small and simple microkernel.

Personality-Neutral Services Architecture

Sitting immediately on top of the kernel are a number of application servers that provide general-purpose system services, the personality-neutral services. These depend only on the microkernel, some generic services exported by a dominant operating system personality server, and themselves. Among the personality-neutral services are the default pager; the master server that loads other personality-neutral services into memory; the low-level name service;

a security service; intialization services; and a set of device drivers and related support code, as well as library routines for a standard programming environment. Additional personality-neutral services, such as a stand-alone file server, may be added by IBM or other vendors. The microkernel and the personality-neutral services are packaged into the IBM microkernel product, separate from any operating system.

Using the microkernel and the personality-neutral services, the dominant personality can provide an operating system environment such as UNIX. Since the dominant personality is an application server, it is possible to add other servers for different personalities executing programs written to different operating systems running on the machine at the same time.

There are some operating system services, such as error-message translation, that are not provided by the personality-neutral services. Since it is best not to duplicate such services, the dominant personality provides them not only to its client applications, but also to any other personalities running on the machine. For instance, the UNIX implementation on the microkernel currently runs as a dominant personality, and supports an environment for running DOS programs as a secondary personality.

The microkernel product is open, allowing any supplier to create dominant or alternate personalities to run it. The requirements on a dominant personality are defined by a documented set of interfaces that it must provide.

The microkernel product is open, allowing any supplier to create dominant or alternate personalities to run it.

Benefits for Developers and Users

The IBM microkernel represents enabling technology for system developers, rather than a revolution for the end user. The modular, scalable, portable environment permits the system developer to create new system functions as applications, rather than within the kernel. It lets hardware developers write device drivers as applications, and makes porting the system to new platforms a relatively small and very well understood job.

But there are some real benefits to the end use. The customer now has a choice: Applications written to different operating systems can execute together on the same machine, permitting the use of exactly the right set of programs for a particular business or organization. The microkernel reduces the time it takes system developers to create new software functions or to use new hardware functions, providing the end user with better technology more rapidly than in the past.

Finally, the microkernel permits the end user to benefit from the emergence of parallel processing and the notions of object-oriented programming, by providing a system that allows applications to use parallelism, and that breaks traditional operating systems up into modular pieces to which object-oriented implementation techniques can be applied.

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"**The computer now acts as my partner and advisor, letting me spend more time with family while helping me improve business effectiveness.** (page 10)

"**A multithreaded program would be able to detach the search-and-replace thread and let me do other things while it was running.** (page 22)

"**Users of other systems cannot fully comprehend the value of the confidence gained from using OS/2.** (page 24)

"**Windows applications fit seamlessly alongside DOS and OS/2 applications on the Workplace Shell desktop.** (page 25)

"**With SQL, you can easily construct queries that reorder data values from only a certain subset of columns.** (page 47)

"**Movies can be recorded in two ways: frame-step or real-time.** (page 52)

"**The main program sends the subroutine off to do a task while the main program continues to execute.** (page 61)

"**I only wish Bill Gates could have been there to see it with his own eyes.** (page 64)

"**Adding alternate personalities will grant you the enhanced flexibility of running additional operating system applications, such as UNIX.** (page 70)

"**None of the code on the microkernel product is specific to any one operating system. Instead, it supports all of them.** (page 73)